WATER BUDGET ANALYSIS FOR CHEYENNE RIVER AT EDGEMONT TO CHEYENNE RIVER AT BUFFALO GAP WITH AND WITHOUT ANGOSTURA RESERVOIR

in Cooperation with the USGS in Rapid City, SD

INTRODUCTION

Evaluating the various proposed alternatives for future operating scenarios has required that methods be developed for making flow projections downstream from Angostura Reservoir. Because of this need, detailed water budgets were developed for various reaches of the Cheyenne River, both upstream and downstream from Angostura Reservoir. All water budgets are derived from the general water-balance equation, which states that the sum of inflows to a water body or river reach must equal the sum of outflows and withdrawals, plus or minus any changes in storage.

Although the general method for development of water budgets is quite simple, accurate budgets depend on the availability of adequate hydrologic information. A relatively large number of USGS streamflow gages have been operated in the study area and additional information also is available from Reclamation's Hydromet data sets, as shown in table 3.1. Hydromet data generally are available for 1953-97; however, USGS data sets cover a wide variety of periods of record. Thus, it was necessary to use various periods of record in developing water budgets; however, no budgets were developed prior to 1955, when the Angostura Irrigation unit became fully operational.

Two distinctly different categories of streams contribute to flow of the Cheyenne River in the vicinity of Angostura Reservoir. Most of the drainage area of the Cheyenne River upstream from Angostura Reservoir consists of prairie grasslands situated in relatively low permeability materials such as clays or shales. Streamflow from these areas generally is intermittent and highly variable (Miller and Driscoll, 1998). Extended periods of zero-flow conditions are common during periods of dry climatic conditions. In contrast, several streams originating within the Black Hills area, which is north of the Cheyenne River, have very steady flow characteristics because of large artesian springs.

WATER BUDGETING FOR REACHES UPSTREAM FROM ANGOSTURA RESERVOIR

Water-budget methods were used to analyze flows upstream from Angostura Reservoir. An initial need was to develop methods for estimating evapotranspiration (ET) along the alluvial bottomlands adjacent to the Cheyenne River and inflows from ungaged tributary areas. To meet this need, flows were analyzed between USGS gaging stations 06395000, Cheyenne River at Edgemont and 06400500, Cheyenne River near Hot Springs, for water year (WY) 1955-72, which is the entire period of record available for the downstream gage (table 3.1). Two other USGS gages have been operated within this reach, which increases in area by 1,567 square miles. Station 06400000, Hat Creek near Edgemont (drainage area 1,044 square miles), had continuous record for this period. Station 06400497, Cascade Springs near Hot Springs (drainage area 0.47 square miles), was not operated during this period; however, the flow of this large spring is very steady (Appendix C) and can be estimated with reasonable accuracy.

Assuming that runoff from the ungaged area (522.5 square miles) is proportional to that of Hat Creek, total runoff between the two main-stem gages can be estimated as flow from Cascade Springs

(which averaged 19.5 cfs for WY1977-95) plus 1.5 times runoff from Hat Creek. Thus, ET within the reach can be calculated as station 06400500 (near Hot Springs) minus 06395000 (Edgemont) minus 1.5 times 06400000 (Hat Creek) minus 19.5 (Cascade Springs). The resulting monthly ET values (table 1) generally show a lot of scatter for months with large runoff; however, values for low-flow months are much more consistent. Median values exhibit a pattern that is consistent with pan evaporation rates for the area. The median values are smoothed to develop estimates of average ET for May through October (table 1), which are the months in which substantial ET typically would occur. The resulting estimates are consistent with estimates that were developed for reservoir evaporation (table 3.2). The annual average for the smoothed monthly values is 4 cfs.

Examination of low-flow values for the stations considered (Appendix C) provides confidence that the ET estimates are reasonable. During extremely low-flow periods, virtually all of the flow within this reach of the Cheyenne River originates from Cascade Springs. This flow may be reduced by ET during the growing season; however, little reduction would occur during the colder months. Examination of records for station 06405000 (near Hot Springs) indicates that during November through April, very few months have occurred with flow less than about 20 cfs. For July through October, when larger ET occurs, flows ranging from 10 to 20 cfs are fairly common. This provides good evidence that ET estimates are reasonable.

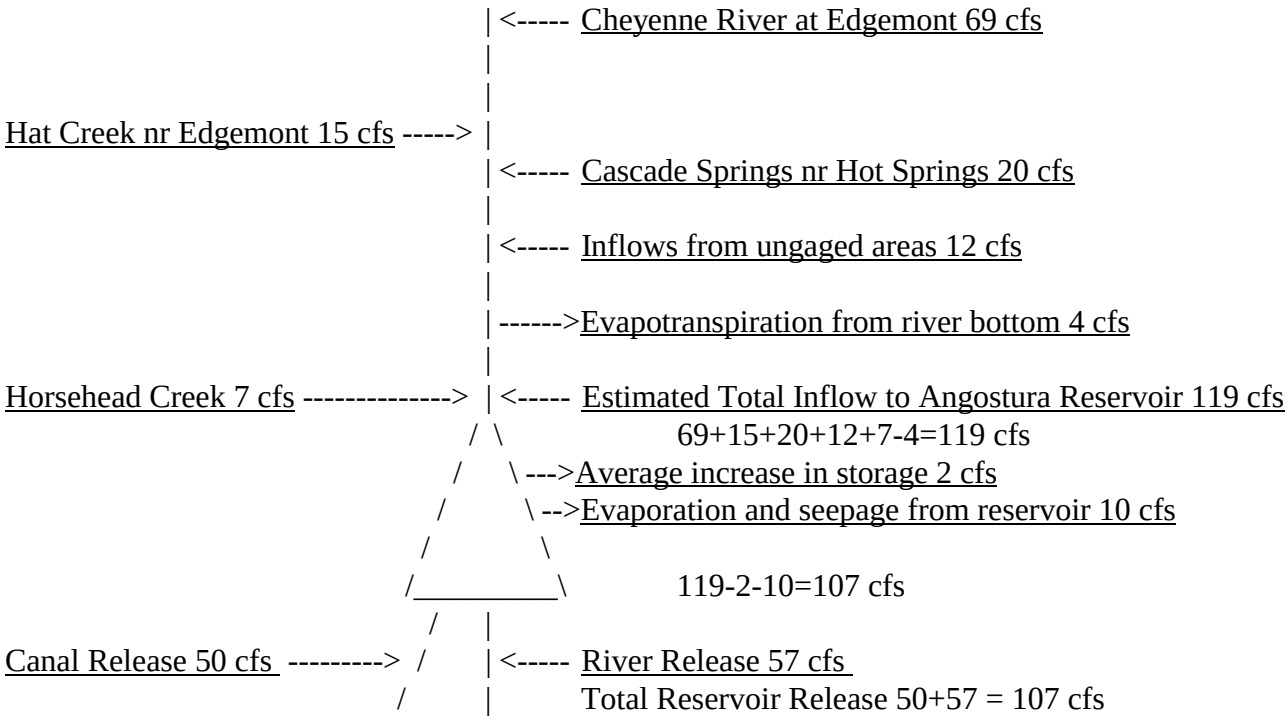
The estimated ET rates were used to develop a water budget for Angostura Reservoir and that reach of the Cheyenne River extending upstream to gaging station 06395000 (Edgemont). This water budget, which is shown in figure 1, is based on a combination of USGS streamflow data, Reclamation Hydromet data, and estimated values. The period of record used is WY1984-97 because streamflow data are available for most of this period for three major tributaries to the reach (Hat Creek, Cascade Springs, and Horsehead Creek). During 1984-97, Hydromet data show that inflows to the reservoir averaged about 119 cfs, of which 2 cfs was retained as increased storage, 10 cfs was lost to evaporation and seepage, and 107 cfs was released from the reservoir. Releases consisted of diversions to the irrigation canal of 50 cfs and releases to the Cheyenne River of 57 cfs. Inflows from measured sources upstream from the reservoir accounted for 111 cfs. Using estimated ET of 4 cfs for the reach, inflows from ungaged areas of about 726 square miles in the reach are calculated as 12 cfs. By comparison, Hat Creek yielded an average of 15 cfs from 1,044 square miles. This information was used to develop a method for estimating flow from ungaged areas near Angostura Reservoir, based on flow in Hat Creek, which has a long period of record. In subsequent water budgets, ungaged flow is estimated as 1.16 times the flow of Hat Creek times the ratio of the ungaged area to the area of Hat Creek.

Table 1: Calculated values of monthly evapotranspiration, in cfs, from Cheyenne River bottomlands between Edgemont and Angostura Reservoir -------

Estimated ET in reach between Cheyenne River at Edgemont and Hot Springs
Estimated ET = Edgemont + 1.5(Hat Cr.)+19.5-Hot Springs

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1951	-1.35	-1.21	-3.01	-2.97	-7.35	-18.67	-4.38	8.70	-29.20	11.70	-46.30	-68.25	-13.52
1952	-3.99	-8.60	-4.81	-2.61	-12.62	47.35	-17.10	69.75	10.00	-45.05	-6.34	5.54	2.63
1953	1.50	0.54	1.60	-1.73	-13.71	59.20	-2.97	51.05	-17.70	12.50	-0.20	-3.94	7.18
1954	-4.39	0.09	-0.46	1.92	-10.30	-4.29	-2.25	33.95	-1.59	-12.07	-14.89	5.92	-0.70
1955	-0.86	-0.77	-1.44	-0.82	-3.59	60.85	-164.35	-26.55	-38.20	-4.20	24.10	25.05	-10.90
1956	-6.14	-2.27	8.80	-4.54	24.11	7.70	-4.82	-3.30	-7.45	20.55	11.85	3.20	3.97
1957	5.66	10.82	2.22	1.14	15.64	14.91	9.35	49.05	47.95	25.60	8.83	10.37	16.79
1958	0.28	-2.76	0.89	1.13	0.67	-2.20	10.70	9.18	18.90	50.45	-56.85	5.47	2.99
1959	4.16	1.79	1.23	3.99	1.12	38.20	-0.51	17.04	22.15	18.70	11.75	10.22	10.82
1960	4.42	2.05	0.54	0.18	-3.61	33.75	-0.76	1.27	16.78	13.93	8.80	5.50	6.90
1961	-1.90	0.16	-3.39	-1.80	3.56	1.26	-2.84	6.66	-4.30	11.59	27.33	4.45	3.40
1962	-2.90	-5.18	0.13	0.04	-6.18	-1.35	0.28	411.05	38.95	-71.65	26.16	2.23	32.63
1963	-9.76	-5.19	0.31	-3.13	13.65	16.70	10.98	25.50	51.00	13.05	4.51	20.05	11.47
1964	2.82	4.21	2.80	-0.79	-6.65	-3.21	3.65	-0.67	54.55	11.51	4.33	2.41	6.25
1965	2.20	2.79	1.70	-2.49	-3.13	-21.68	-20.47	29.30	-0.30	30.50	3.88	8.75	2.59
1966	-1.01	0.08	0.91	-1.69	-0.98	48.35	-3.20	3.40	7.49	27.15	4.45	-1.97	6.91
1967	4.81	-5.66	0.17	-3.54	-18.70	-363.52	14.60	30.60	673.20	-39.70	-3.49	-0.21	24.05
1968	5.88	8.70	6.47	3.01	-10.40	-5.02	171.75	58.20	213.75	63.20	23.45	10.42	45.78
1969	6.84	-0.95	-3.78	-2.42	-3.15	-5.30	-9.02	9.76	37.68	-63.60	-0.13	6.69	-2.28
1970	6.99	-1.96	-8.56	5.26	-36.17	-28.09	10.85	3.07	14.70	1.09	-5.49	8.91	-2.45
1971	-0.30	-0.89	-5.15	-1.05	-28.36	-33.69	-29.29	302.10	20.50	-1.17	11.43	-2.20	19.33
1972	1.36	-3.89	-2.07	-3.41	-64.99	-213.25	-13.30	8.55	39.89	4.33	12.90	3.11	-19.23
Median	0.82	-0.83	0.24	-1.37	-4.90	-1.78	-2.55	13.40	17.84	11.65	4.48	5.49	5.11
Smooth Estimate	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	8.00	12.00	12.00	8.00	4.00

Figure 1: Water Budget for Angostura Reservoir and Upstream Reaches
(1984-97 Period of Record)

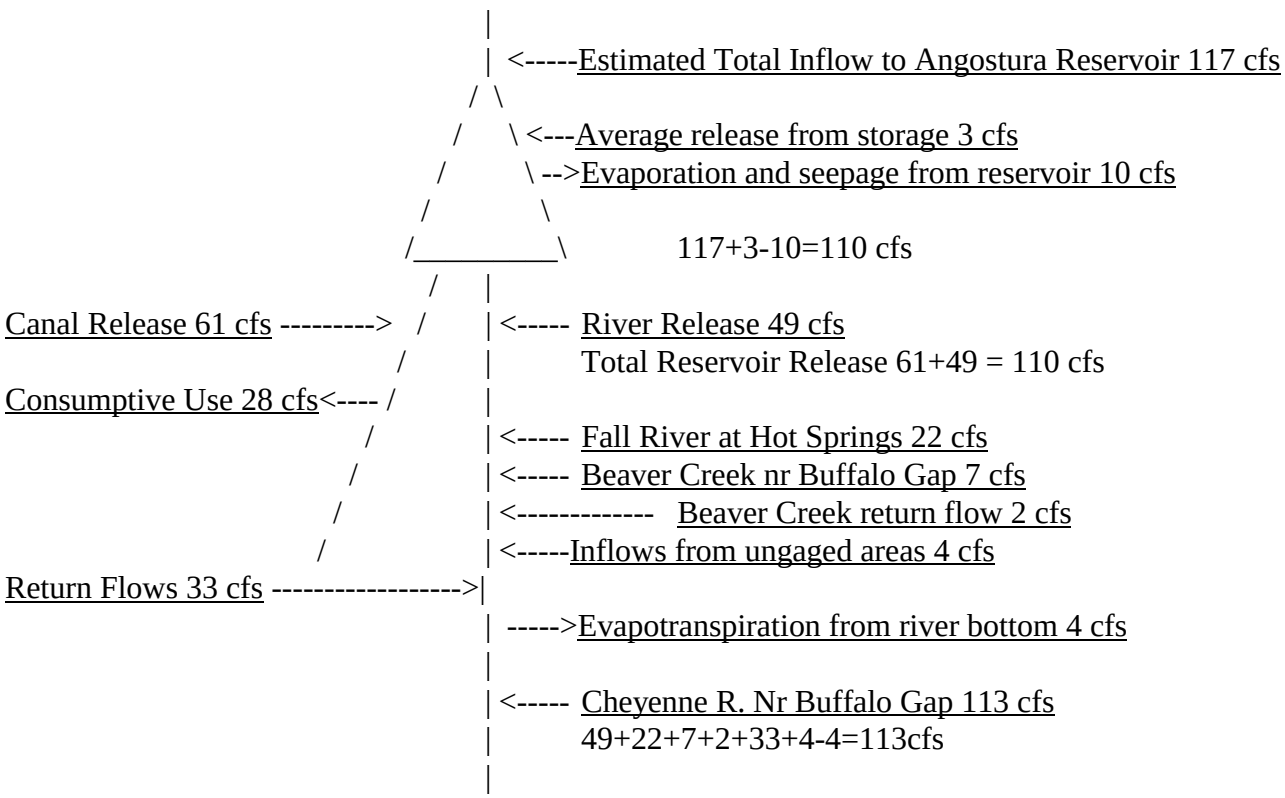


WATER BUDGETING FOR REACHES DOWNSTREAM FROM ANGOSTURA RESERVOIR

Various water-budgets methods also were used to analyze flows downstream from Angostura Reservoir. One need was to estimate return flows from the Angostura Irrigation Unit to the Cheyenne River. Another need was to develop methods for making flow projections for use in evaluating proposed alternatives for future operating scenarios.

Figure 2 shows a water budget for WY1969-80 between Angostura Reservoir and USGS gaging station 06402600, Cheyenne River near Buffalo Gap. Inflows to the reach of river downstream from the reservoir include average releases of 49 cfs and measured tributary inflows of 22 and 7 cfs, respectively, from Fall River and Beaver Creek. Inflows from ungaged tributary areas of 443 square miles are estimated as 4 cfs, based on 1.16 times 443/1,044 (drainage area ratio) times 8.8 (average flow of Hat Creek during WY1969-80). Return flows from irrigated areas along Beaver Creek are estimated as 2 cfs and return flows from the Angostura Irrigation Unit are estimated as 33 cfs. Outflows include flow of about 113 cfs at the downstream end of the reach and estimated ET of 4 cfs, which is based on the same ET estimates that were developed for the reach upstream from the reservoir.

Figure 2: Water Budget for Angostura Reservoir and Downstream Reaches
(1969-80 Period of Record)



The estimated return flows of 33 cfs from the Angostura Irrigation Unit represent about 54 percent of the canal releases of 61 cfs that occurred during WY1969-80. Consumptive use is estimated as 28 cfs, or about 46 percent of the canal releases. Following is a detailed description of how the return flows were estimated.

Return flows were first calculated on a monthly basis for WY1969-80, using monthly data for the inflows and outflows downstream from the reservoir that are identified in figure 2. Calculated monthly values for return flows are shown in table 2. The calculated values are remarkably consistent, with a very limited number of values that deviate from the means or medians for any given month by more than about 20 percent. Most values that deviate substantially are either during winter months, when effects from ice formation can occur, or associated with high-flow events, when measurement accuracy can be relatively poor. The most notable example is for WY1978, when extremely large flows occurred during May and subsequent months. The large negative value for May can only be attributed to measurement error. Because of this large apparent error, the annual mean for WY1978 for station 06402600 (near Buffalo Gap) was adjusted for use in water budgets. This adjustment is described later, in more detail.

The median values are selected as being most representative of typical return flows, because one or more anomalous values, such as May through August of 1978, do not affect the medians as much as the means. Thus, annual return flows from the Angostura Irrigation Unit are estimated as 33 cfs, with monthly values distributed as shown by the medians in table 2. The largest return flows generally occur in August through October and the smallest return flows occur during January through April or May.

Table 2: Calculated monthly return flows, in cfs, from Angostura Irrigation Unit to Cheyenne River

06402600
Cheyenne River near Buffalo Gap minus Buffalo Gap in and out

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1969	37.70	33.06	24.29	9.89	24.26	19.76	18.46	27.27	30.71	150.91	43.59	57.30	39.77
1970	42.92	33.16	44.14	40.37	43.88	29.40	40.67	30.22	36.17	40.19	52.43	52.71	40.52
1971	52.92	31.04	21.02	19.18	43.24	32.91	36.61	-11.53	56.46	33.18	46.48	63.87	35.45
1972	47.69	34.55	32.60	20.64	22.79	17.37	28.41	40.99	94.43	39.97	66.50	58.88	42.07
1973	40.91	38.53	32.19	31.14	30.97	23.98	12.90	20.71	36.78	48.76	38.00	66.72	35.13
1974	45.37	55.07	6.89	-8.07	37.59	47.37	25.13	37.17	26.78	26.52	47.15	45.49	32.7
1975	40.50	37.83	26.94	27.98	26.67	33.20	22.05	38.45	40.75	23.19	31.08	33.61	31.85
1976	43.33	35.03	30.64	10.20	22.83	24.39	32.91	24.82	13.32	18.18	47.49	35.80	28.25
1977	40.33	33.01	34.94	28.07	32.73	27.01	30.08	26.60	12.39	56.88	29.25	49.08	33.37
1978	47.84	34.26	-0.10	5.18	20.14	6.66	15.05	-540.69	-55.72	-69.07	-19.46	43.27	-42.7
1979	38.25	44.69	37.40	20.48	27.56	43.82	-2.82	37.25	41.58	48.51	38.35	39.40	34.54
1980	40.74	39.76	38.09	25.75	-14.90	-25.76	-5.42	30.67	42.05	13.13	39.20	49.05	22.7
Mean	43.21	37.50	27.42	19.23	26.48	23.34	21.17	-19.84	31.31	35.86	38.34	49.60	27.8
Median	41.92	34.79	31.41	20.56	27.11	25.70	23.59	28.75	36.48	36.58	41.40	49.07	33.1

FLOW PROJECTIONS FOR REACHES DOWNSTREAM FROM ANGOSTURA RESERVOIR

The water budget that was developed for the reach downstream from Angostura Reservoir was used to develop a model for making flow projections for this reach. Input for this model consists of monthly values from various Hydromet data sets, USGS streamflow gages, and estimated values for ET, ungaged inflows, and return flows. Hydromet data for reservoir inflows were used as the input for the upstream end of the reach. This data set was modified to eliminate small negative values by establishing a "minimum allowable inflow" for each month equal to the minimum monthly values recorded for gaging station 06400500, Cheyenne River near Hot Springs, during the period of record from WY1944-72. The minimum values range from about 10 to 20 cfs for most months, which realistically reflect minimum inflows from Cascade Springs, which are subject to reductions by ET during dry months. Releases to the river were calculated by adjusting inflows for changes in storage, evaporation from the reservoir and releases to the canal. This method makes the model applicable for projecting downstream flows under other proposed operating alternatives. Inflows to the reach downstream from Angostura Reservoir included measured values for tributary inflows from Fall River and Beaver Creek, as well as estimated inflows from ungaged areas, based on measured flows of Hat Creek. Inflows also included the monthly estimated values for return flows from the Angostura Irrigation Unit and estimated return flows of 2 cfs from irrigation areas along Beaver Creek. The only outflows included in the model are estimated values for ET along the river bottom, which are the "smoothed estimates" that were presented in table 1. Data sets that were used for modeling, as well as various output that was generated, is included in Appendix XX.

The model was calibrated by projecting flows for station 06402600, Cheyenne River near Buffalo Gap, for WY1969-80, as shown in table 3. This table includes statistics for WY1955-97, which corresponds to the period of reservoir operation, and for WY1969-80, which is the period of record for the streamflow gage near Buffalo Gap. Comparison of the projected flows and statistics for WY1969-80, with historic flows and statistics for the streamflow gage (Appendix C) indicates that the model does an excellent job of projecting flows under the current operating scenario. The predicted annual mean for WY1978 is 316 cfs, which is much larger than the historic mean of 243 cfs (Appendix C). The predicted value is much more realistic than the historic value, because of a large discrepancy in historic flow data for May, 1978, for stations 06401500 and 06402600, which is attributed to high-flow measurement inaccuracy. Thus, the projected value was used to derive an adjusted mean flow for WY1969-80 of 113 cfs for station 06402600 (figure 2).

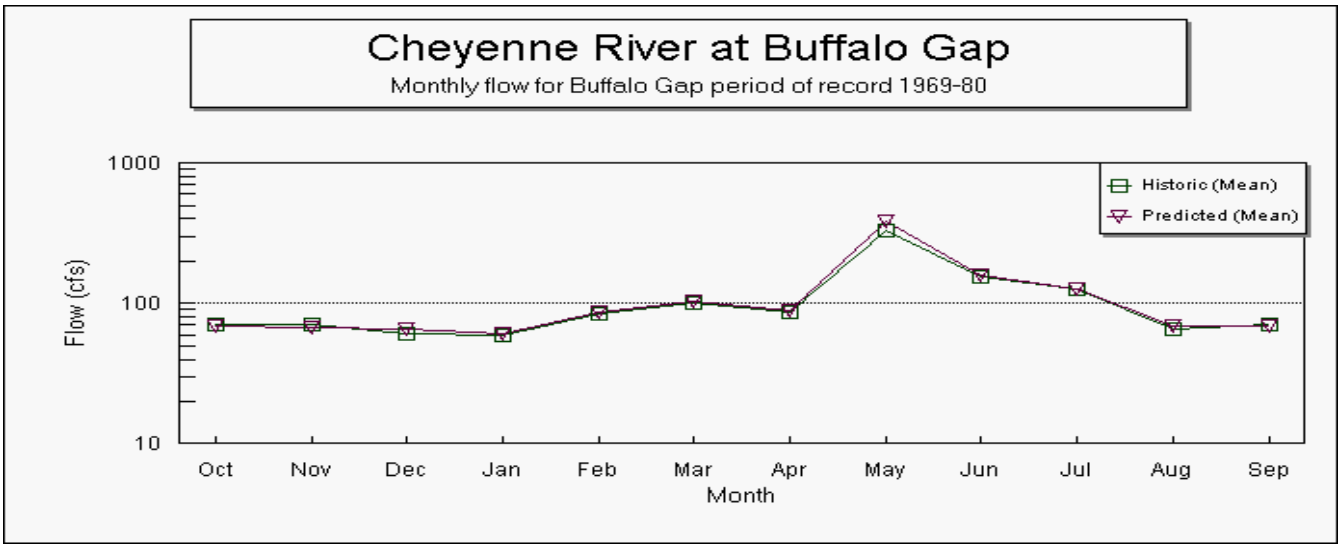
A graphical comparison of historic flows and projected flows for the Cheyenne River near Buffalo Gap is presented in figure 3, which includes six graphs depicting means; maximum values; 75th, 50th, and 25th percentiles; and minimum values. These graphs indicate that projected monthly values are very similar to historic values. The largest discrepancy is in projecting minimum monthly values. Historic minimum values for several months are substantially lower than projected minimum values. Historic minimum values for December and January probably are a result of ice formation within the river channel, which can not be predicted using water-budget methods. Differences between historic flows and projected flows are relatively minor for the 25th percentile and all other categories. This provides confidence that flows can be projected with reasonable accuracy.

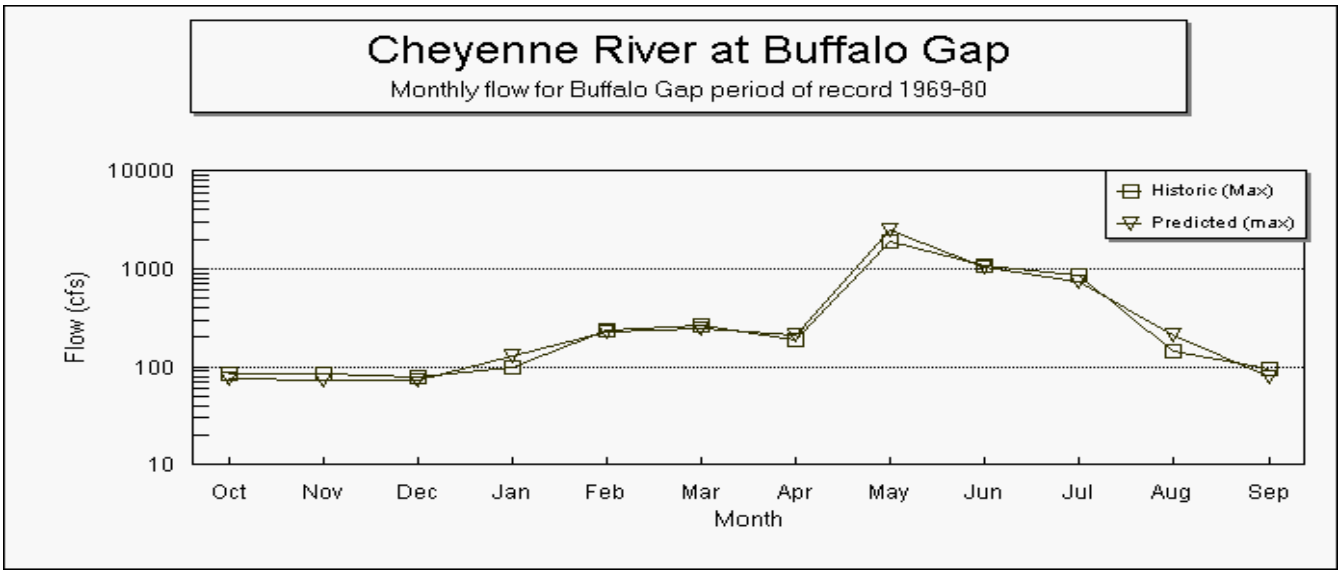
Table 3: Projected monthly flows, in cfs, for USGS gaging station 06402600, Cheyenne River near Buffalo Gap, for current operating scenario

Cheyenne River at Buffalo Gap with Reservoir (Buff In and Out plus Return Flow)

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	81.9	66.7	70.1	56.9	63.1	103.3	241.6	356.1	278.3	126.6	165.5	166.5	148.1
1956	124.8	158.2	161.2	148.5	157.4	155.2	140.2	148.7	102.4	89.0	80.6	85.3	129.3
1957	63.3	64.6	67.1	56.2	64.7	62.0	77.1	750.3	634.1	90.1	57.1	73.4	171.7
1958	74.8	105.7	117.8	115.6	124.5	124.9	74.8	56.7	69.3	333.0	257.7	71.7	127.2
1959	129.8	117.4	125.6	111.9	120.5	77.7	58.0	59.0	66.3	71.3	59.4	67.4	88.3
1960	68.6	71.0	68.6	58.1	64.8	73.5	52.7	53.4	54.2	49.1	55.2	71.0	61.7
1961	60.6	64.7	67.7	57.7	62.8	59.9	50.3	51.9	57.7	59.4	54.6	67.1	59.5
1962	64.4	67.5	67.0	55.3	65.0	68.5	50.4	868.8	2953.8	1315.1	101.4	66.3	478.6
1963	72.6	73.0	65.1	55.9	73.6	98.9	129.1	123.1	772.5	62.9	56.8	77.9	138.4
1964	76.1	74.7	67.2	55.1	61.9	59.8	64.3	56.6	195.0	62.5	54.4	67.0	74.5
1965	65.0	71.6	67.2	58.0	64.7	61.6	57.0	146.3	992.9	224.5	58.6	73.7	161.8
1966	76.6	72.9	68.9	57.6	65.3	221.0	154.2	54.3	53.7	64.7	79.2	73.1	86.8
1967	418.3	68.3	67.3	57.1	65.7	232.4	135.1	176.0	2521.7	298.4	58.1	70.1	347.4
1968	71.8	73.8	70.0	59.7	69.9	61.5	120.7	77.7	489.4	106.1	72.4	73.5	112.2
1969	71.0	69.2	62.7	56.2	64.8	93.9	71.6	53.1	58.5	752.0	59.2	68.0	123.4
1970	74.4	66.0	64.7	51.8	61.0	61.8	60.7	58.9	58.5	47.9	53.2	72.2	60.9
1971	72.7	66.4	63.0	54.3	65.8	63.2	61.5	1443.3	1048.9	55.0	51.2	76.2	260.1
1972	71.0	73.2	72.3	55.0	63.5	65.8	53.8	56.7	72.8	53.1	53.0	66.8	63.1
1973	68.0	66.8	66.8	54.8	65.2	73.2	84.7	179.4	50.5	50.5	53.7	77.7	74.3
1974	70.1	63.8	64.7	127.0	224.9	113.4	188.8	50.9	53.9	47.0	51.8	63.8	93.4
1975	64.5	66.5	63.7	54.2	60.9	59.9	55.3	50.8	58.4	62.2	55.5	73.9	60.5
1976	62.3	63.7	63.3	54.5	62.4	60.8	54.9	62.8	72.2	51.0	60.2	68.8	61.4
1977	68.6	65.9	66.0	53.8	59.3	57.7	55.0	53.8	56.3	49.8	56.1	68.4	59.2
1978	69.3	71.4	66.2	55.1	61.9	128.3	54.1	2478.5	289.8	245.5	207.8	66.7	316.2
1979	72.2	67.7	67.7	56.9	63.3	244.5	207.9	51.1	53.5	51.3	74.5	70.2	90.1
1980	69.7	68.6	65.2	57.5	176.7	213.0	130.6	48.7	50.5	44.2	51.4	64.0	86.7
1981	66.7	69.9	64.5	53.3	59.9	56.1	47.1	52.0	51.6	49.3	60.8	74.7	58.8
1982	69.0	66.2	65.0	53.8	61.8	58.0	52.2	96.2	432.5	88.3	80.5	75.5	99.9
1983	73.0	69.5	76.7	80.5	102.3	149.8	129.9	176.8	71.8	50.8	62.5	63.9	92.2
1984	66.2	68.3	62.9	55.6	64.0	146.2	197.4	679.8	347.4	62.6	60.3	73.8	157.1
1985	73.1	72.2	67.9	50.8	61.4	63.8	51.0	49.1	55.2	46.9	56.8	73.3	60.1
1986	72.8	68.9	68.8	57.1	68.8	108.3	104.1	201.6	768.5	115.8	55.6	74.7	147.1
1987	102.7	108.8	113.2	53.7	109.7	616.0	253.9	149.9	148.1	53.7	56.0	70.1	153.0
1988	73.9	71.6	68.3	59.1	64.4	63.0	51.4	55.5	52.6	48.1	55.9	72.8	61.4
1989	70.4	70.2	65.7	55.4	62.6	60.7	54.2	54.1	57.2	50.8	54.6	70.7	60.6
1990	67.6	71.6	68.6	61.0	65.6	63.4	61.8	57.7	68.1	51.5	62.6	72.2	64.3
1991	71.7	71.5	64.1	56.5	66.6	63.8	65.0	912.4	1586.1	63.7	58.6	70.5	262.5
1992	74.4	69.2	66.6	55.7	62.2	60.4	57.8	50.4	60.4	56.0	54.1	72.3	61.6
1993	70.1	70.0	64.7	53.2	59.6	132.9	136.9	239.4	330.7	196.3	63.4	75.7	124.4
1994	94.4	121.1	95.1	54.7	62.8	677.2	93.0	86.0	60.7	51.8	57.6	74.4	127.4
1995	71.1	70.6	69.2	59.2	70.4	62.6	72.1	103.0	447.1	89.3	67.9	76.1	104.9
1996	79.4	73.9	69.5	58.2	63.6	63.5	70.8	437.5	285.6	64.2	65.3	84.3	118.0
1997	84.7	84.6	76.9	77.5	286.9	739.6	436.9	433.2	590.2	95.1	75.9	82.0	255.3
1955-97 Predicted													
Mean	82.9	75.8	73.6	63.5	82.5	136.8	102.7	265.1	385.6	132.5	71.8	74.4	128.9
Max	418.3	158.2	161.2	148.5	286.9	739.6	436.9	2478.5	2953.8	1315.1	257.7	166.5	478.6
75th	74.6	72.9	69.4	58.1	69.4	130.6	130.2	190.5	439.8	92.6	66.6	74.7	147.6
50th	71.7	70.0	67.2	56.2	64.7	68.5	70.8	77.7	72.2	62.5	58.6	72.3	99.9
25th	68.6	67.1	65.1	54.7	62.5	61.7	54.5	53.9	57.4	50.9	55.3	68.6	62.4
Min	60.6	63.7	62.7	50.8	59.3	56.1	47.1	48.7	50.5	44.2	51.2	63.8	58.8
STD	53.6	18.4	19.5	21.1	46.5	157.1	75.1	449.6	619.1	218.7	40.4	15.0	88.7
1969-80 Predicted													
Mean	69.5	67.4	65.5	60.9	85.8	103.0	89.9	382.3	160.3	125.8	69.0	69.7	112.4
Max	74.4	73.2	72.3	127.0	224.9	244.5	207.9	2478.5	1048.9	752.0	207.8	77.7	316.2
75th	71.3	68.8	66.4	56.4	65.4	117.2	96.2	91.9	72.3	56.8	59.5	72.6	100.9
50th	69.9	66.6	65.0	54.9	63.4	69.5	61.1	55.3	58.5	51.2	54.6	68.6	80.5
25th	68.4	66.0	63.6	54.3	61.7	61.5	55.0	51.1	53.8	49.3	52.7	66.8	61.3
Min	62.3	63.7	62.7	51.8	59.3	57.7	53.8	48.7	50.5	44.2	51.2	63.8	59.2
STD	3.2	2.7	2.5	20.0	52.4	60.7	52.9	737.7	275.5	196.3	42.3	4.3	81.5
1969-80 Historic													
Mean	70.8	70.1	61.5	59.6	85.2	100.6	87.5	333.7	155.2	125.1	65.9	70.3	107.1
Max	83.7	84.1	77.4	98.3	235.4	262.6	190.3	1909.0	1069.0	866.3	146.9	95.4	262.5
75th	75.3	73.1	72.3	63.3	78.8	115.8	83.8	94.5	79.8	64.9	67.6	76.4	102.2
50th	68.5	70.0	65.1	59.1	64.4	71.0	70.3	60.0	57.2	54.1	59.5	66.3	76.3
25th	67.0	64.3	54.9	51.1	60.2	64.0	60.8	57.0	50.5	45.8	50.0	60.5	66.1
Min	63.1	62.6	34.7	39.7	54.9	57.5	45.6	50.6	32.3	20.7	43.9	55.6	56.5
STD	5.9	6.1	13.1	14.7	49.7	58.3	46.0	601.1	279.1	225.3	26.4	12.4	67.5

Figure 3: Graphical Comparison of Historic Flows and Projected Flows for USGS gaging station 06402600, Cheyenne River near Buffalo Gap





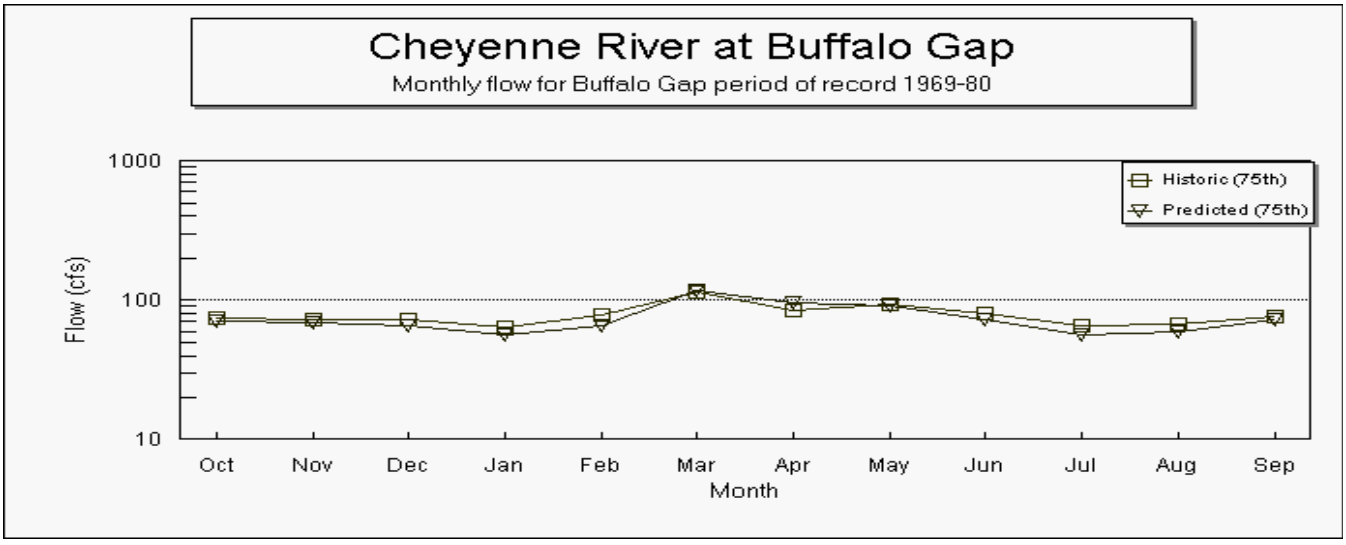
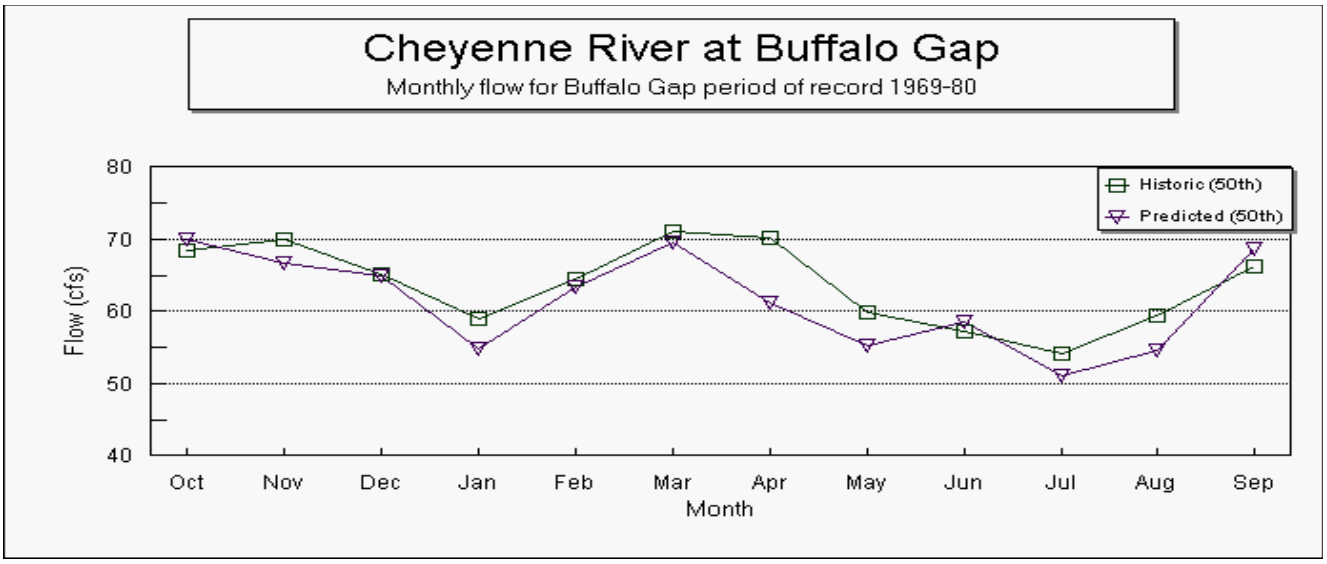
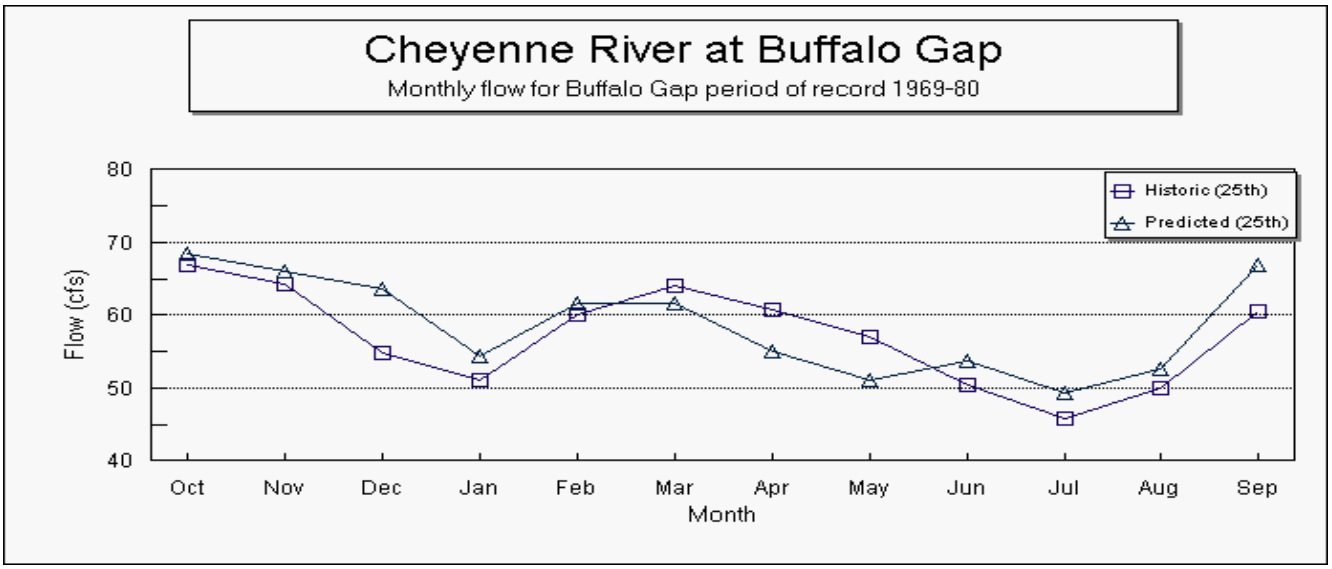
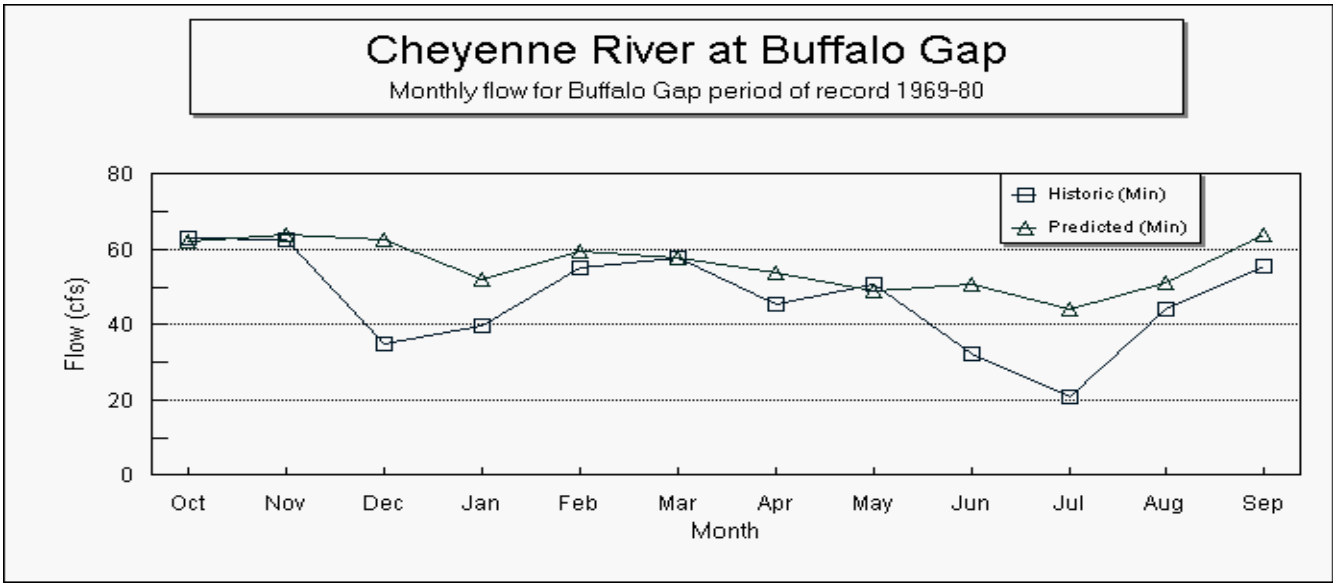


Figure 3 Continued



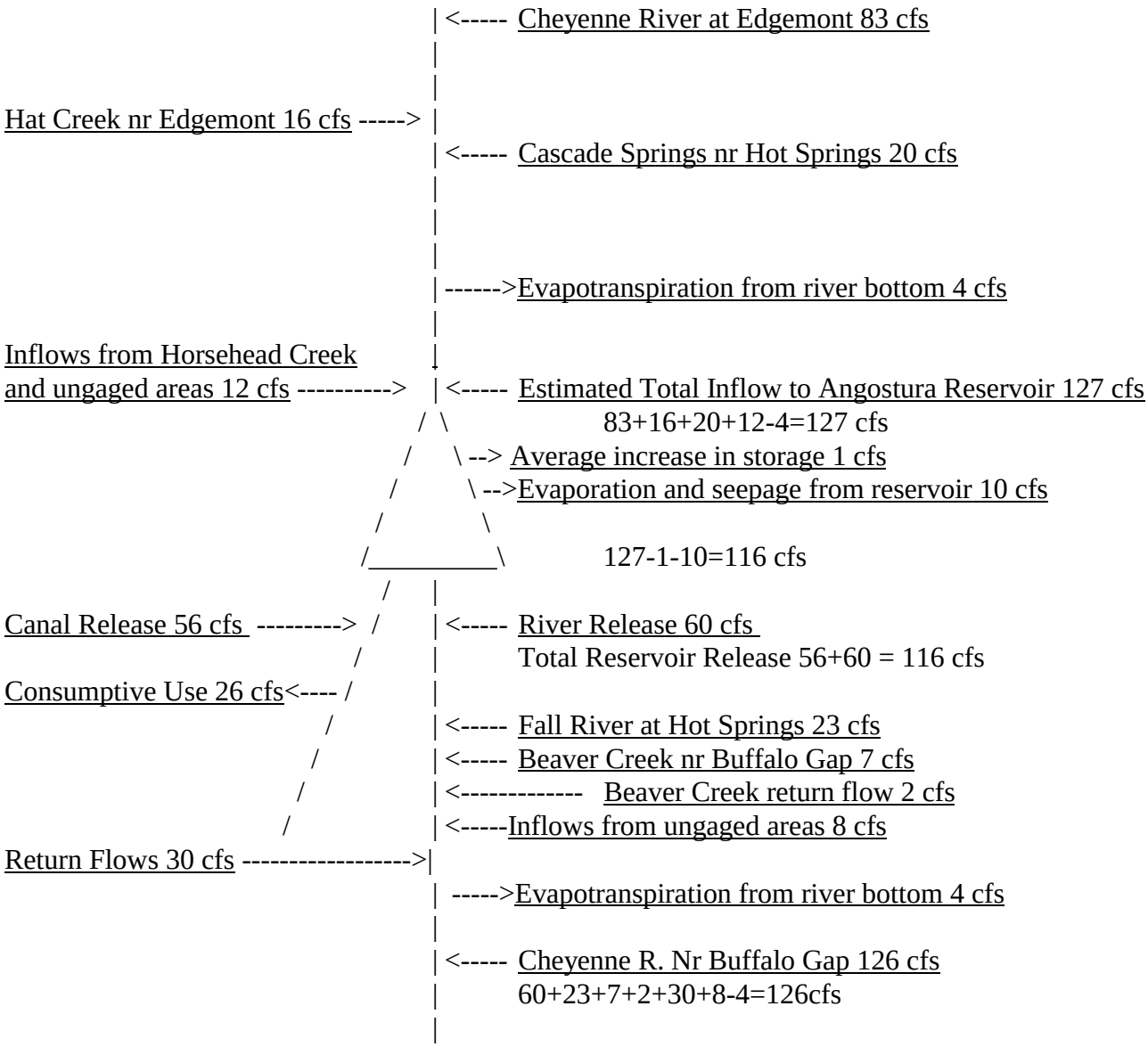




OVERALL WATER BUDGET FOR CURRENT OPERATING SCENARIO

Figure 4 shows an overall water budget for WY1955-97 for Angostura Reservoir, including both upstream and downstream reaches. Hydromet data for reservoir inflows and outflows and USGS streamflow data, when available, were used as the primary basis for the overall water budget. Other values were estimated as necessary, or derived from previous water budgets.

Figure 4: Overall Water Budget for Angostura Reservoir and Adjacent Reaches
(1955-97 Period of Record)



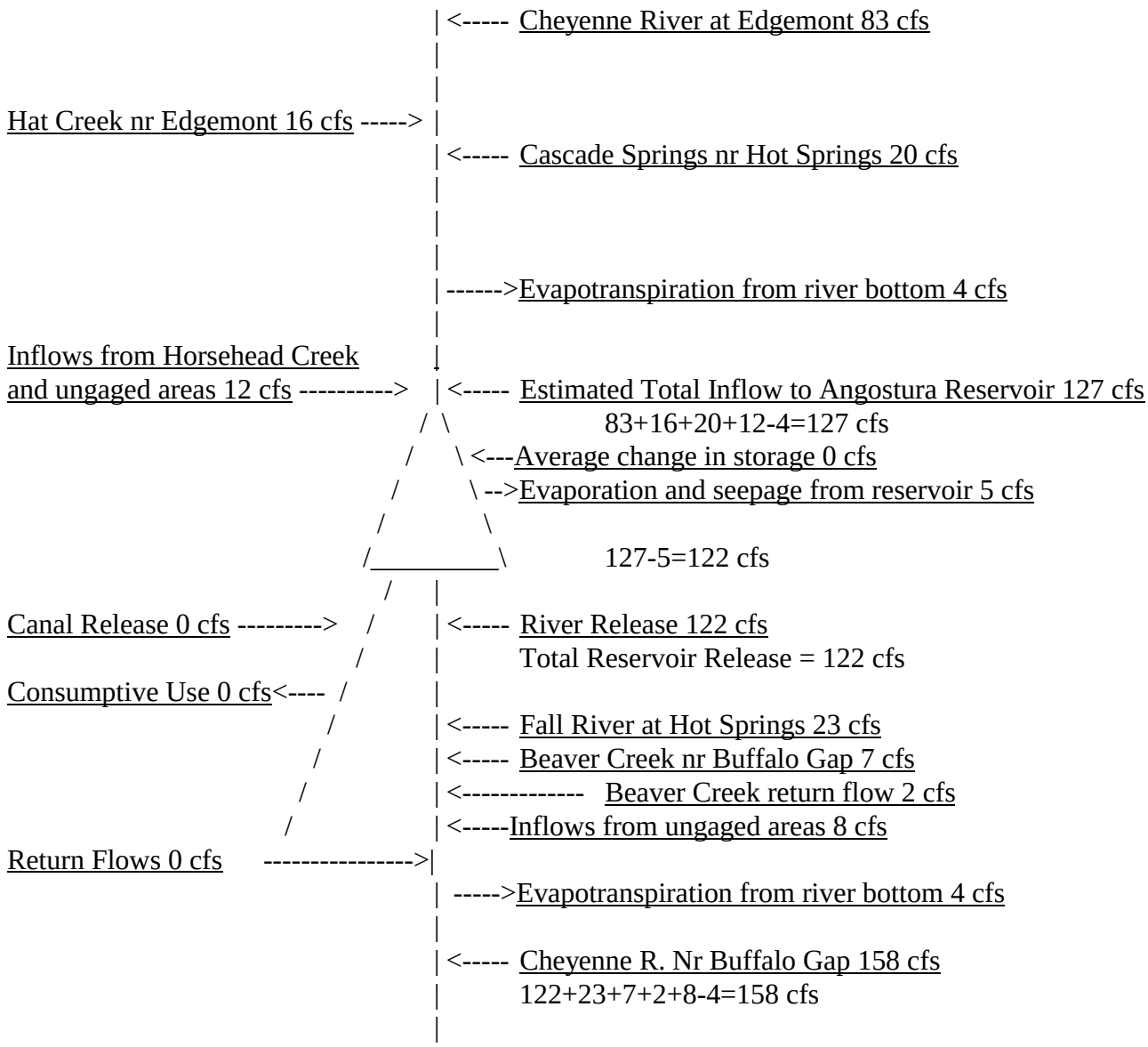
Total inflows to Angostura Reservoir during WY1955-97 were about 127 cfs. During this period, measured flows of the Cheyenne River averaged 83 cfs and 16 cfs was contributed by Hat Creek. Inflow from Cascade Springs is estimated as 20 cfs. ET along the river bottom between Edgemont and the reservoir is estimated as 4 cfs. Thus, inflows from Horsehead Creek (which only has streamflow records for WY1984-97) and other ungaged areas in the reach, are estimated as 12 cfs.

Within the reservoir, storage increased by an average of 1 cfs during WY 1955-97 and evaporation and seepage from the reservoir is estimated as 10 cfs. Total releases from the reservoir averaged 116 cfs, of which 60 cfs was released to the river and 56 cfs was diverted to the irrigation canal. Return flows to the river are estimated as 54 percent of the canal diversion, or about 30 cfs and the remaining 26 cfs is consumed as evapotranspiration within the irrigation unit. Measured inflows to the Cheyenne River downstream from the reservoir include 23 cfs from Fall River and 7 cfs from Beaver Creek. Return flows from irrigated areas along Beaver Creek are estimated as 2 cfs and inflows from ungaged areas are estimated as 8 cfs, based on the long-term flow records for Hat Creek. ET from the river bottom is estimated as 4 cfs. Summing the inflows to the reach and subtracting estimated ET, a long-term flow estimate of 126 cfs is derived for the Cheyenne River downstream from the Angostura Irrigation Unit. This estimate applies to the location of the USGS stream gage that was operated near Buffalo Gap during WY1969-80.

WATER BUDGET AND FLOW PROJECTIONS FOR PASS-THROUGH OPERATING SCENARIO

One alternative that has been identified for future operations is that the reservoir would be operated as a pass-through facility with the spillway gates removed or fully opened. Under this scenario, the typical pool elevation would be near the bottom of the spillway gates, which are at elevation 3157.2 ft. Under this scenario, the typical pool area would be about 2,000 acres and annual evaporation (and seepage) from the reservoir would be reduced from 10 to 5 cfs. Under this scenario, all flows would be passed through to the river downstream and no water would be diverted to the irrigation canal. Thus, changes in reservoir storage, consumptive uses, and return flows from the irrigation unit would be eliminated. A water budget based on these assumptions and using flow data for WY1955-97, is shown in figure 5. Thus, this water budget is based on the same inflows to the reservoir as the overall water budget shown in figure 4. For this period, estimated flows downstream from the irrigation unit under the pass-through scenario would increase by an average of about 32 cfs from the current operating scenario.

Figure 5: Water Budget for Pass-Through Operating Scenarios
(Based on flow data for 1955-97)



Potential changes in the monthly distribution of flows under the pass-through scenario were examined using the model that was developed for making flow projections downstream from Angostura Reservoir, which was described in a previous section. Projected flows for WY1955-97 for gaging station 06402600, Cheyenne River near Buffalo Gap, were presented in table 3. As discussed earlier, this model was calibrated by comparing projections with historic flow data for WY1969-80, with projected flows corresponding very closely with historic flows (figure 3).

Projected flows under a pass-through operating scenario, for WY1955-97, are presented in table 4, which also includes "adjusted" summary statistics of projected flows for the current operating scenario. These "adjusted" summary statistics were derived by subtracting 3 cfs from the summary statistics for WY1955-97 that were presented in table 3. This was done because all values in table 3 were based on calculated return flows of 33 cfs for WY1969-80, when canal releases averaged 61 cfs. During WY1955-97, however, canal releases averaged only 56 cfs and return flows were estimated as 30 cfs (figure 4).

Table 4: Projected monthly flows, in cfs, for USGS gaging station 06402600, Cheyenne River near Buffalo Gap, for pass-through operating scenario, with comparison to statistics for current operating scenario

Cheyenne River at Buffalo Gap Without Reservoir (Flow Through)
Res min adj inflow + Fall R. + Beaver Cr. + Beaver Cr. return + Ungaged Trib minus Res Evap pass thru - ET

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	41.29	46.74	54.50	55.49	64.46	322.82	916.83	338.93	293.58	45.60	504.27	311.86	249.7
1956	39.21	49.21	113.15	86.59	89.82	185.64	66.34	185.24	199.43	18.58	41.02	23.12	91.4
1957	31.40	55.93	65.35	61.11	80.70	129.52	163.87	1559.67	654.35	147.09	130.91	52.12	261.0
1958	58.24	71.52	53.82	56.78	81.65	135.94	232.64	48.21	140.52	962.93	281.19	26.06	179.1
1959	37.69	49.77	56.31	55.93	55.29	157.77	58.13	56.52	215.03	149.17	10.58	32.49	77.9
1960	40.02	55.01	60.08	62.36	69.89	203.49	53.22	43.24	100.18	20.74	10.36	21.22	61.7
1961	31.45	45.73	58.87	60.22	59.25	64.70	43.72	41.85	36.72	78.98	38.64	22.61	48.6
1962	37.06	49.37	54.17	54.29	146.94	160.86	43.07	2134.19	2916.72	1406.75	121.85	20.86	595.5
1963	70.40	53.27	52.84	58.90	207.77	181.99	119.53	177.04	807.45	104.81	14.90	127.54	164.7
1964	41.96	53.91	54.36	53.78	64.35	85.24	139.70	103.48	480.85	57.70	11.17	22.63	97.4
1965	32.34	51.52	58.97	67.82	75.04	132.66	131.55	506.99	1016.05	350.20	43.96	42.98	209.2
1966	97.42	59.59	59.84	61.82	73.34	356.87	138.05	33.56	23.40	240.99	319.68	33.50	124.8
1967	94.21	69.77	60.75	74.89	126.41	235.82	131.58	225.02	2616.92	355.30	13.86	41.63	328.8
1968	39.80	69.46	68.59	72.41	98.70	166.35	173.69	98.70	657.67	129.44	119.44	58.74	146.1
1969	38.14	59.67	54.52	61.56	69.49	227.90	117.84	127.99	116.11	944.79	19.81	23.02	155.1
1970	43.65	57.20	63.92	53.80	102.34	155.94	160.19	119.54	29.42	12.44	24.22	26.73	70.8
1971	53.85	58.86	57.32	56.32	119.98	175.24	416.87	1527.23	1050.09	34.36	8.32	39.85	299.9
1972	65.21	83.81	71.25	57.91	151.65	364.61	70.75	71.10	128.59	35.41	45.07	21.94	97.3
1973	53.92	64.17	59.88	64.44	82.33	153.28	176.99	404.97	59.67	134.03	27.32	294.89	131.3
1974	72.87	79.71	72.76	196.74	216.01	150.10	204.01	33.24	23.62	11.78	33.02	18.75	92.7
1975	39.12	74.25	55.78	58.94	58.99	215.12	275.69	92.40	142.38	57.40	18.46	24.50	92.8
1976	32.75	47.44	70.29	63.09	92.26	142.30	81.31	89.87	271.47	58.15	60.76	24.72	86.2
1977	37.93	49.07	54.94	55.49	64.20	108.10	135.65	41.36	53.63	62.45	41.24	80.78	65.4
1978	63.03	59.18	62.86	61.15	61.90	902.12	109.87	2595.02	353.91	508.81	305.14	30.16	426.1
1979	51.31	55.06	69.43	67.00	61.81	296.49	184.32	72.95	73.69	158.04	340.49	27.43	121.5
1980	39.31	57.46	54.61	65.14	280.45	204.98	111.82	43.29	87.09	9.23	78.58	19.43	87.6
1981	38.96	56.58	71.72	74.64	77.57	61.21	40.10	55.26	21.95	214.88	158.93	26.91	74.9
1982	56.01	56.00	58.60	58.30	104.33	128.82	63.38	348.44	814.41	135.68	187.10	113.00	177.0
1983	130.50	78.60	67.88	83.46	185.64	138.23	128.35	182.96	104.60	56.27	79.80	18.98	104.6
1984	63.85	69.13	60.39	71.87	185.10	358.03	188.41	694.04	344.54	38.81	44.07	35.26	179.5
1985	58.68	70.79	61.12	59.16	64.37	174.11	63.34	31.04	25.99	48.73	59.16	40.05	63.0
1986	55.12	56.39	61.19	65.58	192.55	464.94	429.25	247.37	824.17	152.59	13.09	155.99	228.2
1987	246.72	72.47	63.30	73.66	171.59	605.87	238.66	179.41	146.69	16.95	17.09	34.29	155.6
1988	40.14	63.28	63.53	58.76	72.27	109.51	49.35	57.77	20.36	29.94	40.57	40.33	53.8
1989	36.77	55.43	58.31	56.06	60.67	113.79	63.51	64.63	24.86	27.90	13.19	114.82	57.5
1990	41.78	63.77	63.21	66.34	73.84	152.98	90.77	116.25	47.60	54.72	37.78	29.23	69.9
1991	46.61	58.99	53.28	57.50	77.33	83.77	70.15	1848.05	1569.59	61.65	12.90	26.12	330.5
1992	44.08	69.32	62.70	64.55	87.37	86.13	56.01	37.48	53.91	68.05	31.52	34.03	57.9
1993	40.93	56.91	57.55	59.75	63.24	535.24	367.18	227.88	382.01	332.38	155.72	52.00	194.2
1994	73.73	55.08	64.34	79.70	172.25	652.26	99.20	71.38	26.86	21.17	31.05	25.23	114.4
1995	71.87	53.97	70.69	84.19	140.92	122.16	99.98	376.84	514.36	72.62	32.44	39.06	140.1
1996	63.68	86.25	65.26	71.23	135.76	268.33	200.40	467.96	272.63	23.38	66.73	62.63	148.7
1997	70.58	85.97	76.73	134.02	748.72	707.96	423.22	411.42	593.51	212.18	131.49	44.38	303.3
1955-97 Predicted													
Mean	57.3	61.3	62.8	68.9	122.5	241.8	165.8	376.6	424.1	178.2	87.8	54.9	158.5
Max	246.7	86.2	113.1	196.7	748.7	902.1	916.8	2595.0	2916.7	1406.7	504.3	311.9	595.5
75th	63.8	69.4	65.3	71.5	143.9	282.4	186.4	363.6	553.9	155.3	120.6	48.2	186.8
50th	44.1	57.5	60.7	61.8	82.3	166.3	128.3	119.5	146.7	62.5	41.0	33.5	124.8
25th	39.2	54.5	56.8	58.1	67.0	131.1	68.2	57.1	53.6	34.9	19.1	24.6	82.0
Min	31.4	45.7	52.8	53.8	55.3	61.2	40.1	31.0	20.4	9.2	8.3	18.8	48.6
STD	35.4	10.7	9.8	23.9	110.2	186.5	154.2	599.7	615.0	281.6	108.6	62.8	111.0
Adjusted summary statistics for predicted 1955-97 flows under current operating scenario													
Mean	79.9	72.8	70.6	60.5	79.5	133.8	99.7	262.1	382.6	129.5	68.8	71.4	125.9
Max	415.3	155.2	158.2	145.5	283.9	736.6	433.9	2475.5	2950.8	1312.1	254.7	163.5	475.6
75th	71.6	69.9	66.4	55.1	66.4	127.6	127.2	187.5	436.8	89.6	63.6	71.7	144.6
50th	68.7	67.0	64.2	53.2	61.7	65.5	67.8	74.7	69.2	59.5	55.6	69.3	96.9
25th	65.6	64.1	62.1	51.7	59.5	58.7	51.5	50.9	54.4	47.9	52.3	65.6	59.4
Min	57.6	60.7	59.7	47.8	56.3	53.1	44.1	45.7	47.5	41.2	48.2	60.8	55.8

A graphical comparison of projected flows for the Cheyenne River near Buffalo Gap, for the pass-through and current operating scenarios during WY1955-97, is presented in figure 6. This figure includes six graphs depicting means; maximum values; 75th, 50th, and 25th percentiles; and minimum values. Values for the current operating scenario are taken from the adjusted summary statistics that were presented in table 4. The annual mean for the pass-through scenario would be about 32-33 cfs larger than for the current operating scenario (table 4). This increase would result primarily from reduced evaporation in the reservoir and elimination of consumptive use within the Angostura Irrigation Unit (figures 4 and 5). The monthly distribution of the increase would not be uniform, however (figure 6). For the months of September through December, mean flows for the pass-through scenario would be smaller than for the current operating scenario. Projected increases during February through July for the pass-through scenario would be larger than the average increase (table 4).

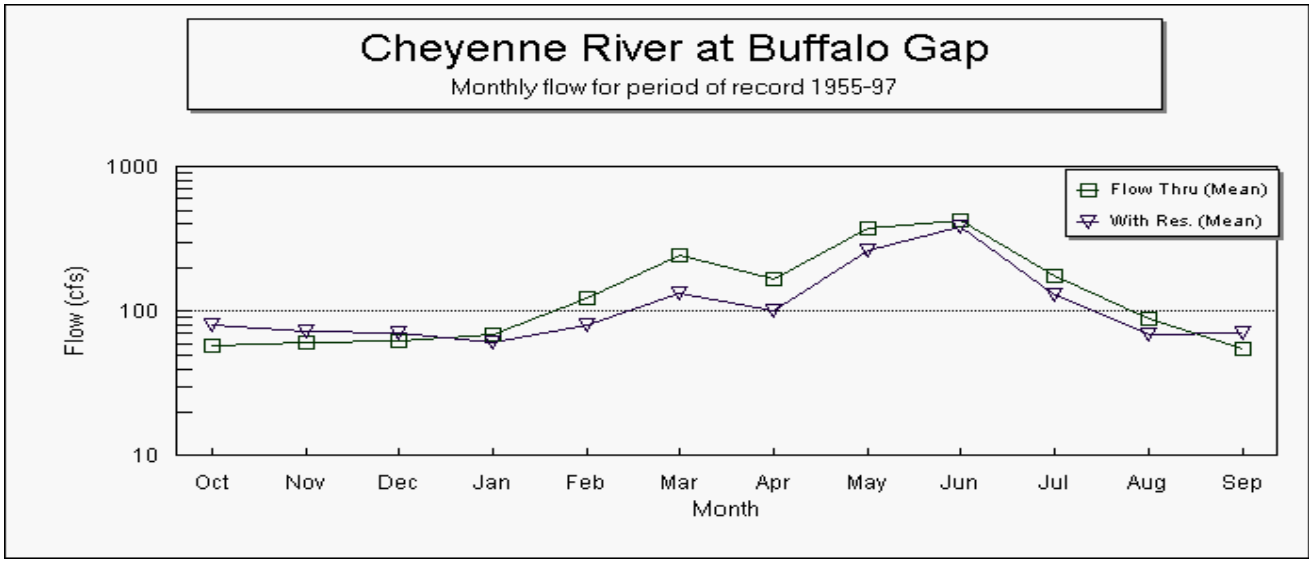
The 75th percentiles portray moderately high-flow conditions, when there frequently would be storage available (for the current operating scenario) to accommodate moderately high flows. Projected 75th percentile flows for the pass-through scenario would be substantially larger during February through August than for the current operating scenario. The 75th percentile values for September and October, however, would be smaller for the pass-through scenario than for the current operating scenario.

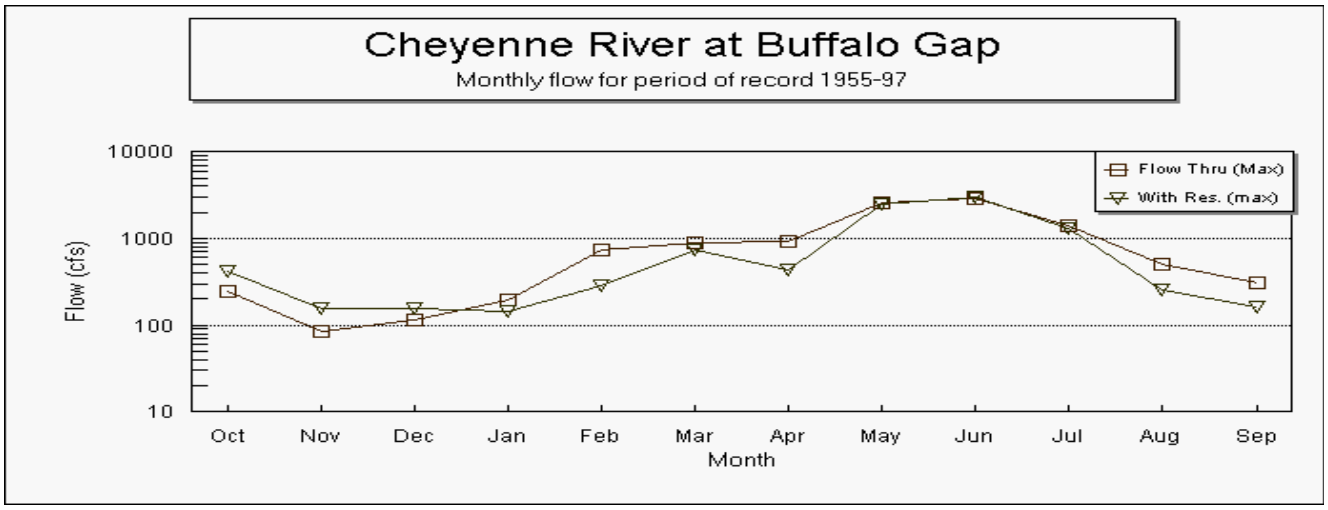
The median (50th percentile) projected flows during March through June would be substantially larger for the pass-through scenario than for the current operating scenario. For several months, projected median flows would be quite similar for both scenarios; however, projected median flows for September and October would be substantially smaller for the pass-through scenario than for the current operating scenario.

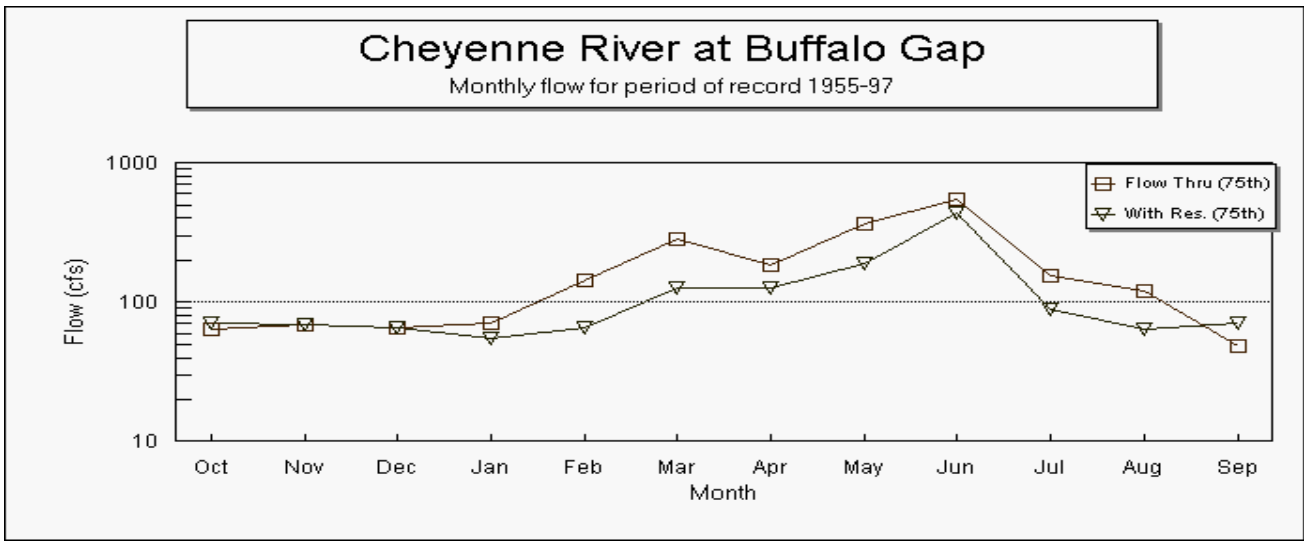
The 25th percentiles, which portray moderately low-flow conditions, would be quite similar under both scenarios, for much of the year. For March, projected flows for the pass-through scenario would be larger than for the current operating scenario. However, projected 25th percentile flows for August through October would be substantially smaller for the pass-through scenario than for the current operating scenario. Minimum projected flows would be quite similar under both scenarios for December through April; however, minimum flows for the remainder of the year would be substantially smaller for the pass-through scenario than for the current operating scenario.

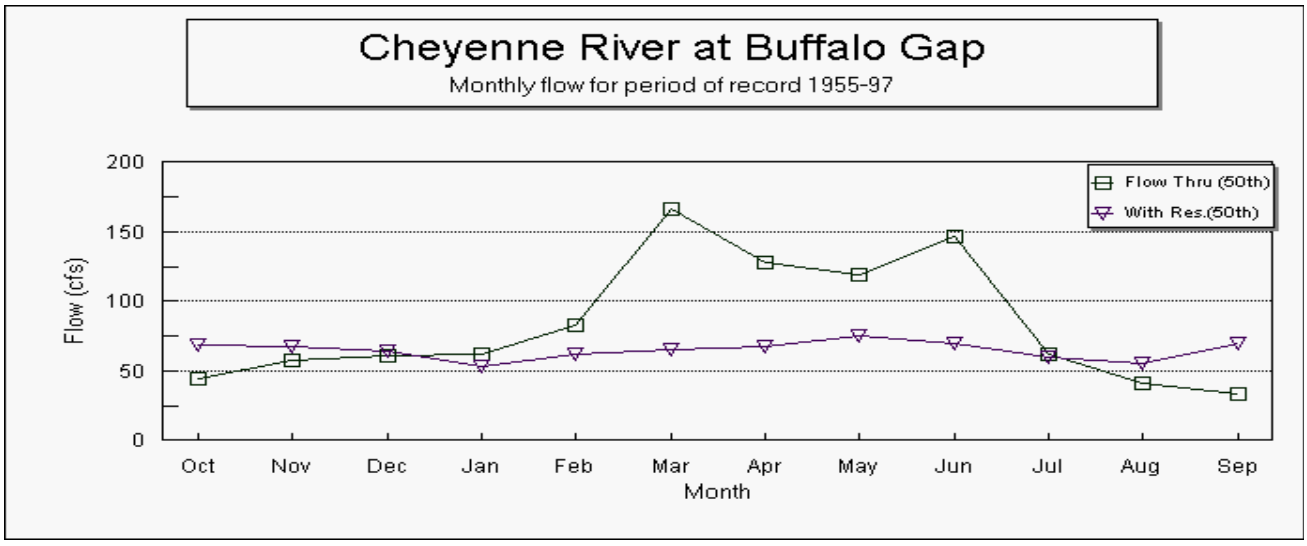
It should be noted that the flow projections for both scenarios are unable to portray the full range of variability in minimum flow conditions that would actually occur. This is because the projections are based on average monthly values for reservoir evaporation, ET from the river bottom, and return flows. If actual variability could be incorporated in the flow projections, minimum flow values for both scenarios probably would be smaller for all or most months. In spite of this shortcoming, the flow projections do provide an excellent portrayal of probable flow distributions for both scenarios and are a realistic basis for comparisons between the two scenarios.

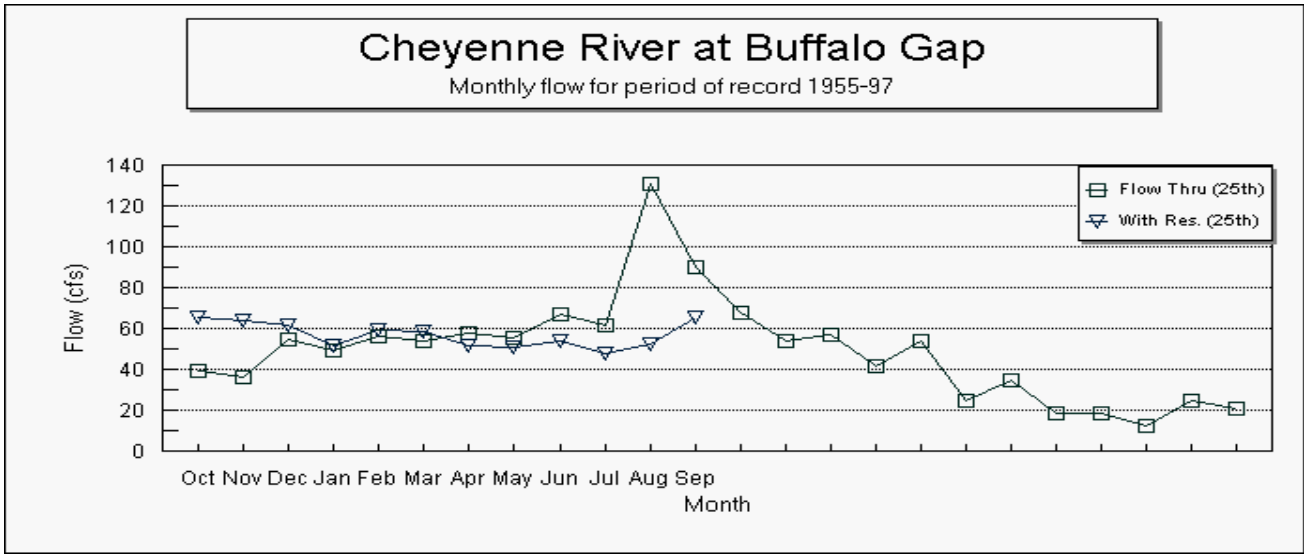
Figure 6: Graphical Comparison of Projected Flows for USGS gaging station 06402600, Cheyenne River near Buffalo Gap, for pass-through and current (With Res.) operating scenarios

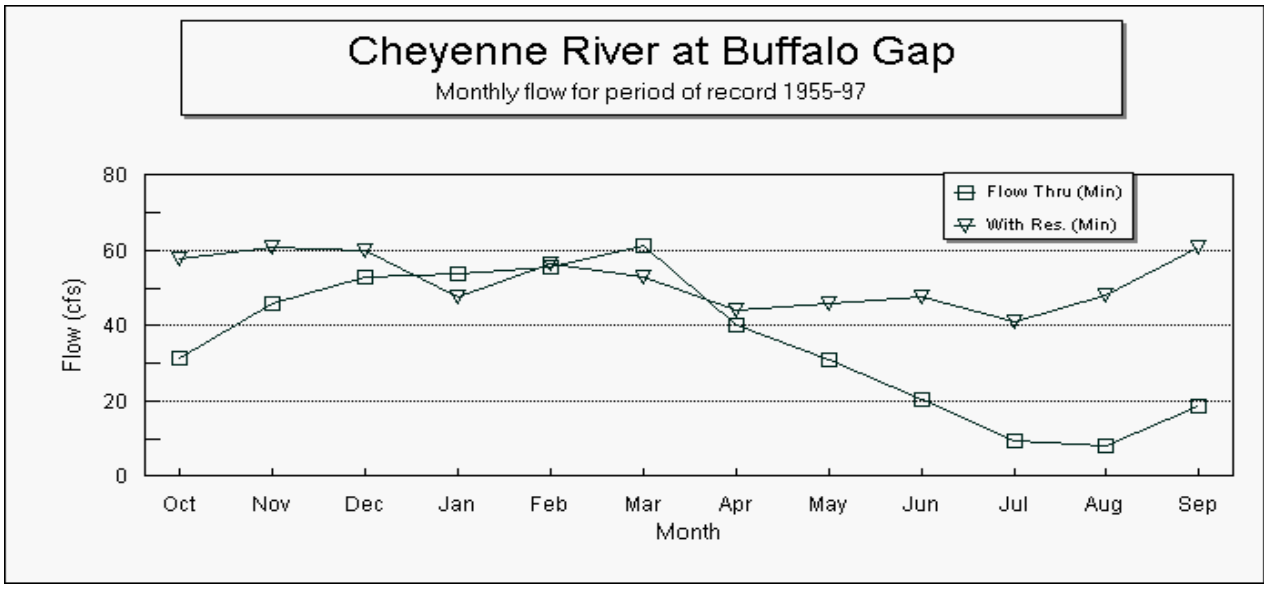







Cheyenne River at Buffalo Gap
Monthly flow for period of record 1955-97
Flow Thru (50th)
With Res.(50th)
Flow (cfs)
200
150
100
50
0
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Month


Cheyenne River at Buffalo Gap
Monthly flow for period of record 1955-97
Flow Thru (25th)
With Res. (25th)
Flow (cfs)
140
120
100
80
60
40
20
0
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Month


Cheyenne River at Buffalo Gap
Monthly flow for period of record 1955-97
Flow Thru (Min)
With Res. (Min)
Flow (cfs)
80
60
40
20
0
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Month

Comparisons of historic and projected flows for station 06402600, Cheyenne River near Buffalo Gap, provided confidence that flow projections were realistic (table 3 and figure 3). A qualitative analysis of flow projections for the pass-through scenario indicates that projected flows are consistent with actual hydrologic flow conditions for the Cheyenne River and tributaries in the vicinity of Angostura Reservoir. During minimum flow conditions, the flow of the Cheyenne River at Edgemont is very small and zero-flow conditions frequently occur at this site. Similarly, the majority of the intermediate drainage area between Edgemont and the downstream extent of the Angostura Irrigation Unit would produce very little, if any, tributary inflow during minimum flow conditions. The exceptions would be the return flows from the irrigation unit and the tributaries that consistently have relatively large flows resulting from artesian springflow, such as Cascade Springs, Fall River, and Beaver Creek. Under the current operating scenario, the minimum releases from the reservoir to the river are very small and base flow downstream consists primarily of return flows and inflows from Fall River and Beaver Creek. During December through April, the estimated return flows (table 2) are quite similar to the minimum flows of about 20 cfs upstream from the reservoir, that would be contributed by Cascade Springs. Because those flows currently are stored during minimum flow conditions, and evaporative effects during December through April are minimal, minimum flows during these months would be similar under both scenarios, as shown in figure 6. During other months, inflows to the reservoir can be small (about 10-15 cfs) because of ET along the river bottom. Evaporation from a reduced pool (2,000 acres)
would still be substantial during some months; thus, minimum outflows from the reduced reservoir pool would be very small during some months, which is similar to the current operating scenario. The net effect would be a large reduction in minimum flow conditions during May through November, downstream from the irrigation unit, resulting from elimination of irrigation return flows under a pass-through scenario.

In summary, for a pass-through operating scenario, average flows downstream from the irrigation unit would increase by about 32 to 33 cfs, relative to the current operating scenario. The change in the distribution of monthly flows would not be uniform, however. The analysis of monthly flow distribution shows that under a pass-through scenario, flows during low-flow conditions (generally less than about the 25th percentile) would be reduced for most months, relative to the current operating scenario. For mid-range flow values (generally about the 25th through 75th percentiles), the pass-through scenario would result in larger flows for many months; however, flow values for late-summer or early-fall months may not increase. For high-flow conditions (generally those above the 75th percentile) values would increase for most, but not all months under the pass-through scenario. Depending on the amount of storage available at any time, peaks for some moderately high-flow events currently are stored within the reservoir; however, peaks are passed through when no storage is available. Most of the largest peaks generally would be passed through the reservoir under either scenario, because storage usually is inadequate to store the largest flows.

Attachment A

Supporting Data

The following table shows a water budget for Cheyenne River between Angostura Dam and Buffalo Gap for a 45 year period of record for historic 1953-97 and future alternatives 1998-2042. The Angostura Reservoir river and canal releases are based on the AGRAOP Model. The Cheyenne accretions, irrigation consumptive use, and irrigation return flows are based on the water budget completed for the Angostura EIS.

Cheyenne River Water Budget from the Dam to Buffalo Gap Gage (cfs)

Alternative	Irrigated Acres	Reservoir Min. Elev.	Reservoir River Release	Cheyenne River Accretion	Reservoir Canal Release	Canal Req.	CIR Use	Return Flow	Cheyenne River At Buffalo Gap
Historic	10,500	3163	59.9	36	55.2	N/A	25.4	29.8	125.7
No Action	12,218	3163	60.2	36	55.1	57.8	25.3	29.8	126.0
No Action	10,000	3163	68.4	36	46.4	47.3	21.3	25.1	129.5
Flow Through	N/A	3157.2	120.7	36	0	0.0	0.0	0.0	156.7
Recreation	12,218	3170	62.3	36	53.5	57.8	24.6	28.9	127.2
Recreation	10,000	3170	70.0	36	45.3	47.3	20.8	24.5	130.5
Imp. Efficiency	12,218	3163	68.9	36	45.7	46.5	21.0	24.7	129.6
Imp. Efficiency	12,218	3170	70.6	36	44.7	46.5	20.6	24.1	130.7
Imp. Efficiency	12,218	3175	71.5	36	43.6	46.5	20.1	23.5	131.0
Imp. Efficiency	12,218	3184	86.1	36	27.8	46.5	12.8	15.0	137.1
Imp. Efficiency	10,000	3163	76.3	36	37.7	38.0	17.3	20.4	132.7
Imp. Efficiency	10,000	3170	77.3	36	37.5	38.0	17.3	20.3	133.6
Imp. Efficiency	10,000	3175	78.0	36	36.8	38.0	16.9	19.9	133.9
Imp. Efficiency	10,000	3184	88.8	36	25.0	38.0	11.5	13.5	138.3

Note: Historic 45 year period of study is 1953-1997 (calendar year).
The Alternatives based on the 45 year period of study 1998-2042 (calendar year).

Column Definition:
Column 1 is Alternatives developed for the EIS.
Column 2 is irrigated acres associated with each alternative.
Column 3 is Reservoir minimum elevation associated with each alternative.
Column 4 is Reservoir river releases associated with each alternative.
Column 5 is Cheyenne River accretions based on records for Fall River, Beaver Creek, Beaver Creek return flow, ungaged inflows, and evaportranspiration from river bottom between the dam and Buffalo Gap Gage (23+7+2+8-4=36).
Column 6 is Reservoir canal releases associated with each alternative.
Column 7 is Canal Requirement of 18.74 inches/acre based on Modified Blaney-Criddle Method with 76% canal efficiency and 60 % on-farm efficiency. Improved Efficiency was based on 81% canal efficiency and 70 % on-farm efficiency. This is a good indication of canal shortages when comparing canal release.
Column 8 is District irrigation consumptive use (46% of canal releases).
Column 9 is District irrigation return flow (54% of canal releases).
Column 10 is Cheyenne River at Buffalo Gap Gage (Column 4 +5 +8)

Angostura Reservoir Monthly Minimum adjusted inflow (cfs)

Mins used	15.1	17.7	18.3	17.9	19.7	30.7	21.1	16.3	14.0	13.3	10.5	12.5	
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	21.14	17.70	18.30	19.16	28.81	245.58	847.00	307.38	270.57	43.91	450.50	255.44	210.5
1956	15.10	17.70	68.31	43.69	50.42	144.74	40.33	157.76	179.82	13.30	35.78	12.50	65.0
1957	15.10	28.57	29.27	25.48	43.21	92.70	114.28	1317.34	573.07	128.48	128.48	36.97	211.1
1958	30.90	35.29	18.30	19.49	41.41	91.08	186.54	27.65	114.28	896.12	274.85	12.50	145.7
1959	15.10	17.70	18.30	17.98	19.70	105.71	33.61	32.53	194.94	126.85	10.50	21.85	51.2
1960	19.52	21.85	22.77	24.91	32.41	156.13	28.57	24.40	90.75	21.14	10.50	12.50	38.8
1961	15.10	18.49	22.77	23.12	23.41	30.70	21.10	24.40	23.53	66.68	39.03	12.50	26.7
1962	21.14	20.17	18.30	19.60	109.84	118.72	21.10	2080.10	2831.74	1369.38	118.72	12.50	561.8
1963	45.54	18.49	19.52	23.66	162.05	128.48	89.07	156.13	736.08	91.08	11.38	107.56	132.4
1964	15.10	17.70	18.30	19.31	28.81	50.42	104.19	81.32	440.31	55.30	10.50	12.50	71.1
1965	15.10	18.49	22.77	30.42	37.81	95.95	102.51	434.23	966.32	310.63	39.03	26.89	175.0
1966	68.31	25.21	22.77	24.82	36.01	273.23	104.19	16.30	14.00	224.44	294.37	18.49	93.5
1967	69.30	38.65	24.40	38.37	88.23	200.04	97.47	191.91	1887.26	313.88	10.50	28.57	249.0
1968	15.10	33.61	29.27	33.31	55.82	130.11	80.67	55.30	504.17	79.69	102.46	42.01	96.8
1969	15.10	28.57	22.77	25.96	32.41	180.52	87.39	112.22	102.51	915.63	14.64	12.50	129.2
1970	17.89	28.57	30.90	22.59	68.42	120.35	127.72	102.46	14.00	13.30	24.40	12.50	48.6
1971	29.27	30.25	26.02	22.62	81.03	138.24	383.17	1392.15	966.32	29.27	10.50	21.85	260.9
1972	42.28	48.74	30.90	23.56	115.24	325.27	45.38	50.42	105.88	32.53	45.54	12.50	73.2
1973	34.15	35.29	24.40	30.27	45.01	105.71	121.00	354.54	52.10	131.73	27.65	275.61	103.1
1974	52.04	53.78	39.03	150.24	169.26	115.47	136.13	16.30	14.00	13.30	35.78	12.50	67.3
1975	22.77	45.38	22.77	25.34	25.21	180.52	248.72	74.81	127.72	43.91	16.26	12.50	70.5
1976	17.89	21.85	39.03	29.21	57.62	107.34	55.46	61.80	243.68	55.30	53.67	13.44	63.0
1977	17.89	20.17	21.14	22.28	32.41	76.44	109.24	22.77	42.01	61.80	39.03	68.90	44.5
1978	42.28	25.21	27.65	26.65	27.01	800.16	84.03	2535.47	339.47	507.42	302.50	20.17	394.8
1979	29.27	25.21	32.53	30.70	25.21	256.96	156.29	55.30	63.86	156.13	318.76	13.44	97.0
1980	17.89	26.89	21.14	28.30	219.67	162.63	78.99	29.27	80.67	13.30	81.32	12.50	64.4
1981	21.14	25.21	39.03	41.98	45.01	30.90	21.10	37.41	14.00	213.05	151.25	12.50	54.4
1982	35.78	26.89	24.40	25.11	70.22	95.95	40.33	286.24	709.19	128.48	161.01	94.11	141.5
1983	105.71	47.06	34.15	49.36	151.25	104.09	97.47	141.49	89.07	53.67	74.81	12.50	80.1
1984	45.54	38.65	29.27	36.89	147.65	325.27	149.57	613.13	273.93	24.40	39.03	18.49	145.2
1985	34.15	36.97	24.40	29.02	30.61	136.61	40.33	16.30	14.00	52.04	56.92	25.21	41.4
1986	30.90	25.21	24.40	29.09	151.25	401.71	352.92	211.42	705.83	133.36	10.50	137.81	184.5
1987	217.93	42.01	30.90	40.55	131.44	533.44	196.63	149.62	122.68	13.30	14.64	18.49	126.0
1988	17.89	33.61	29.27	21.96	36.01	74.81	28.57	39.03	14.00	32.53	39.03	26.89	32.8
1989	16.26	25.21	26.02	22.94	27.01	81.32	38.65	47.16	14.00	27.65	13.01	104.19	37.0
1990	26.02	35.29	30.90	32.64	39.61	118.72	62.18	97.58	28.57	55.30	37.41	21.85	48.8
1991	30.90	31.93	26.02	26.38	43.21	50.42	38.65	1650.74	1482.25	53.67	10.50	15.13	288.3
1992	21.14	40.33	29.27	31.06	54.02	53.67	26.89	21.14	38.65	61.80	29.27	18.49	35.5
1993	19.52	25.21	24.40	27.12	30.61	427.73	285.69	200.04	334.43	292.74	149.62	33.61	154.2
1994	45.54	21.85	29.27	46.60	138.65	608.25	65.54	52.04	14.00	19.52	32.53	13.44	90.6
1995	55.30	26.89	37.41	50.16	102.63	87.82	63.86	325.27	431.90	43.91	21.14	16.81	105.3
1996	34.15	50.42	27.65	33.86	99.03	230.94	163.01	401.71	236.96	13.30	58.55	43.69	116.1
1997	43.91	50.42	39.03	85.44	696.83	668.43	384.85	362.67	492.40	169.14	110.59	20.17	260.3
Mean	35.4	30.3	27.8	33.3	84.9	196.8	129.3	334.1	372.0	165.2	81.8	40.3	127.6
Min	15.1	17.7	18.3	18.0	19.7	30.7	21.1	16.3	14.0	13.3	10.5	12.5	26.7
10 pctile	15.1	18.5	18.5	20.1	27.0	57.9	28.6	23.1	14.0	13.3	10.5	12.5	39.3
25 pctile	17.9	21.8	22.8	23.3	32.4	94.3	40.3	38.2	40.3	30.9	15.5	12.5	58.7
Median	26.0	26.9	26.0	27.1	45.0	128.5	89.1	102.5	127.7	55.3	39.0	18.5	96.8
75 pctile	42.3	36.1	30.9	33.6	106.2	238.3	142.8	316.3	466.4	144.7	106.5	31.1	150.0
90 pctile	54.6	46.7	38.7	46.0	151.3	422.5	278.3	1,176.5	920.3	313.2	252.1	102.2	258.1
Max	217.9	53.8	68.3	150.2	696.8	800.2	847.0	2,535.5	2,831.7	1,369.4	450.5	275.6	561.8

Note: Minimum used are minimums at Hot Springs

Angostura Reservoir monthly calibrated adjusted inflow (cfs)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	21.1	13.4	16.3	19.2	28.8	245.6	847.0	307.4	270.6	43.9	450.5	255.4	209.9
1956	13.0	15.1	68.3	43.7	50.4	144.7	40.3	157.8	179.8	-11.4	35.8	-5.0	61.0
1957	6.5	28.6	29.3	25.5	43.2	92.7	114.3	1317.3	573.1	128.5	128.5	37.0	210.4
1958	30.9	35.3	16.3	19.5	41.4	91.1	186.5	27.6	114.3	896.1	274.9	-8.4	143.8
1959	8.1	8.4	16.3	18.0	16.2	105.7	33.6	32.5	194.9	126.9	-1.6	21.8	48.4
1960	19.5	21.8	22.8	24.9	32.4	156.1	28.6	24.4	90.8	21.1	6.5	11.8	38.4
1961	13.0	18.5	22.8	23.1	23.4	29.3	18.5	24.4	23.5	66.7	39.0	8.4	25.9
1962	21.1	20.2	16.3	19.6	109.8	118.7	18.5	2080.1	2831.7	1369.4	118.7	3.4	560.6
1963	45.5	18.5	19.5	23.7	162.1	128.5	89.1	156.1	736.1	91.1	11.4	107.6	132.4
1964	6.5	5.0	9.8	19.3	28.8	50.4	104.2	81.3	440.3	55.3	-16.3	1.7	65.5
1965	4.9	18.5	22.8	30.4	37.8	96.0	102.5	434.2	966.3	310.6	39.0	26.9	174.2
1966	68.3	25.2	22.8	24.8	36.0	273.2	104.2	8.1	-10.1	224.4	294.4	18.5	90.8
1967	69.3	38.7	24.4	38.4	88.2	200.0	97.5	191.9	1887.3	313.9	8.1	28.6	248.9
1968	4.9	33.6	29.3	33.3	55.8	130.1	80.7	55.3	504.2	79.7	102.5	42.0	95.9
1969	14.6	28.6	22.8	26.0	32.4	180.5	87.4	112.2	102.5	915.6	14.6	-1.7	128.0
1970	17.9	28.6	30.9	22.6	68.4	120.3	127.7	102.5	-21.8	11.4	24.4	-5.0	44.0
1971	29.3	30.3	26.0	22.6	81.0	138.2	383.2	1392.2	966.3	29.3	9.8	21.8	260.8
1972	42.3	48.7	30.9	23.6	115.2	325.3	45.4	50.4	105.9	32.5	45.5	8.4	72.8
1973	34.2	35.3	24.4	30.3	45.0	105.7	121.0	354.5	52.1	131.7	27.6	275.6	103.1
1974	52.0	53.8	39.0	150.2	169.3	115.5	136.1	-3.3	-10.1	13.0	35.8	11.8	63.6
1975	22.8	45.4	22.8	25.3	25.2	180.5	248.7	74.8	127.7	43.9	16.3	-11.8	68.5
1976	17.9	21.8	39.0	29.2	57.6	107.3	55.5	61.8	243.7	55.3	53.7	13.4	63.0
1977	17.9	20.2	21.1	22.3	32.4	76.4	109.2	22.8	42.0	61.8	39.0	68.9	44.5
1978	42.3	25.2	27.6	26.7	27.0	800.2	84.0	2535.5	339.5	507.4	302.5	20.2	394.8
1979	29.3	25.2	32.5	30.7	25.2	257.0	156.3	55.3	63.9	156.1	318.8	13.4	97.0
1980	17.9	26.9	21.1	28.3	219.7	162.6	79.0	29.3	80.7	-8.1	81.3	1.7	61.7
1981	21.1	25.2	39.0	42.0	45.0	30.9	11.8	37.4	11.8	213.1	151.3	-42.0	48.9
1982	35.8	26.9	24.4	25.1	70.2	96.0	40.3	286.2	709.2	128.5	161.0	94.1	141.5
1983	105.7	47.1	34.2	49.4	151.3	104.1	97.5	141.5	89.1	53.7	74.8	1.7	79.2
1984	45.5	38.7	29.3	36.9	147.6	325.3	149.6	613.1	273.9	24.4	39.0	18.5	145.2
1985	34.2	37.0	24.4	29.0	30.6	136.6	40.3	-3.3	1.7	52.0	56.9	25.2	38.7
1986	30.9	25.2	24.4	29.1	151.3	401.7	352.9	211.4	705.8	133.4	8.1	137.8	184.3
1987	217.9	42.0	30.9	40.6	131.4	533.4	196.6	149.6	122.7	6.5	14.6	18.5	125.4
1988	17.9	33.6	29.3	22.0	36.0	74.8	28.6	39.0	13.4	32.5	39.0	26.9	32.8
1989	16.3	25.2	26.0	22.9	27.0	81.3	38.7	47.2	10.1	27.6	13.0	104.2	36.6
1990	26.0	35.3	30.9	32.6	39.6	118.7	62.2	97.6	28.6	55.3	37.4	21.8	48.8
1991	30.9	31.9	26.0	26.4	43.2	50.4	38.7	1650.7	1482.3	53.7	6.5	15.1	288.0
1992	21.1	40.3	29.3	31.1	54.0	53.7	26.9	21.1	38.7	61.8	29.3	18.5	35.5
1993	19.5	25.2	24.4	27.1	30.6	427.7	285.7	200.0	334.4	292.7	149.6	33.6	154.2
1994	45.5	21.8	29.3	46.6	138.6	608.3	65.5	52.0	10.1	19.5	32.5	13.4	90.3
1995	55.3	26.9	37.4	50.2	102.6	87.8	63.9	325.3	431.9	43.9	21.1	16.8	105.3
1996	34.2	50.4	27.6	33.9	99.0	230.9	163.0	401.7	237.0	-9.8	58.5	43.7	114.2
1997	43.9	50.4	39.0	85.4	696.8	668.4	384.8	362.7	492.4	169.1	110.6	20.2	260.3
Mean	34.3	29.6	27.5	33.3	84.8	196.8	129.0	333.0	369.5	163.4	80.6	35.7	126.4
Min	4.9	5.0	9.8	18.0	16.2	29.3	11.8	(3.3)	(21.8)	(11.4)	(16.3)	(42.0)	25.9
10 pctile	9.1	18.5	16.9	20.1	27.0	57.9	28.6	23.1	10.1	11.7	8.1	(4.4)	38.5
25 pctile	17.9	21.8	22.8	23.3	32.4	94.3	40.3	38.2	40.3	30.9	15.5	8.4	55.0
Median	26.0	26.9	26.0	27.1	45.0	128.5	89.1	102.5	127.7	55.3	39.0	18.5	95.9
75 pctile	42.3	36.1	30.9	33.6	106.2	238.3	142.8	316.3	466.4	144.7	106.5	31.1	149.7
90 pctile	54.6	46.7	38.7	46.0	151.3	422.5	278.3	1,176.5	920.3	313.2	252.1	102.2	258.0
Max	217.9	53.8	68.3	150.2	696.8	800.2	847.0	2,535.5	2,831.7	1,369.4	450.5	275.6	560.6

NOTE: Inflows corrected for July 1958, and adjusted for evaporation and Area-Capacity for October 1966 and September 1981 118.54
Inflows calibrated to historic EOM Content by AGRAOP model.

Estimated ET in reach between Cheyenne River at Edgemont and Hot Springs
Estimated ET = Edgemont + 1.5(Hat Cr.)+19.5-Hot Springs

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1951	-1.35	-1.21	-3.01	-2.97	-7.35	-18.67	-4.38	8.70	-29.20	11.70	-46.30	-68.25	-13.52
1952	-3.99	-8.60	-4.81	-2.61	-12.62	47.35	-17.10	69.75	10.00	-45.05	-6.34	5.54	2.63
1953	1.50	0.54	1.60	-1.73	-13.71	59.20	-2.97	51.05	-17.70	12.50	-0.20	-3.94	7.18
1954	-4.39	0.09	-0.46	1.92	-10.30	-4.29	-2.25	33.95	-1.59	-12.07	-14.89	5.92	-0.70
1955	-0.86	-0.77	-1.44	-0.82	-3.59	60.85	-164.35	-26.55	-38.20	-4.20	24.10	25.05	-10.90
1956	-6.14	-2.27	8.80	-4.54	24.11	7.70	-4.82	-3.30	-7.45	20.55	11.85	3.20	3.97
1957	5.66	10.82	2.22	1.14	15.64	14.91	9.35	49.05	47.95	25.60	8.83	10.37	16.79
1958	0.28	-2.76	0.89	1.13	0.67	-2.20	10.70	9.18	18.90	50.45	-56.85	5.47	2.99
1959	4.16	1.79	1.23	3.99	1.12	38.20	-0.51	17.04	22.15	18.70	11.75	10.22	10.82
1960	4.42	2.05	0.54	0.18	-3.61	33.75	-0.76	1.27	16.78	13.93	8.80	5.50	6.90
1961	-1.90	0.16	-3.39	-1.80	3.56	1.26	-2.84	6.66	-4.30	11.59	27.33	4.45	3.40
1962	-2.90	-5.18	0.13	0.04	-6.18	-1.35	0.28	411.05	38.95	-71.65	26.16	2.23	32.63
1963	-9.76	-5.19	0.31	-3.13	13.65	16.70	10.98	25.50	51.00	13.05	4.51	20.05	11.47
1964	2.82	4.21	2.80	-0.79	-6.65	-3.21	3.65	-0.67	54.55	11.51	4.33	2.41	6.25
1965	2.20	2.79	1.70	-2.49	-3.13	-21.68	-20.47	29.30	-0.30	30.50	3.88	8.75	2.59
1966	-1.01	0.08	0.91	-1.69	-0.98	48.35	-3.20	3.40	7.49	27.15	4.45	-1.97	6.91
1967	4.81	-5.66	0.17	-3.54	-18.70	-363.52	14.60	30.60	673.20	-39.70	-3.49	-0.21	24.05
1968	5.88	8.70	6.47	3.01	-10.40	-5.02	171.75	58.20	213.75	63.20	23.45	10.42	45.78
1969	6.84	-0.95	-3.78	-2.42	-3.15	-5.30	-9.02	9.76	37.68	-63.60	-0.13	6.69	-2.28
1970	6.99	-1.96	-8.56	5.26	-36.17	-28.09	10.85	3.07	14.70	1.09	-5.49	8.91	-2.45
1971	-0.30	-0.89	-5.15	-1.05	-28.36	-33.69	-29.29	302.10	20.50	-1.17	11.43	-2.20	19.33
1972	1.36	-3.89	-2.07	-3.41	-64.99	-213.25	-13.30	8.55	39.89	4.33	12.90	3.11	-19.23
Median	0.82	-0.83	0.24	-1.37	-4.90	-1.78	-2.55	13.40	17.84	11.65	4.48	5.49	5.11
Smooth Estimate	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	8.00	12.00	12.00	8.00	4.00

06402000
Fall River at Hot Springs

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	23.6	23.8	23.4	23.2	23.9	26.6	21.6	23.5	24.7	23.5	24.5	28.2	24.2
1956	24.9	23.0	24.6	28.0	24.7	23.2	21.9	23.2	21.5	21.4	24.2	24.5	23.8
1957	23.0	22.3	21.0	21.0	21.8	21.8	21.8	23.1	26.6	22.6	22.1	24.6	22.6
1958	24.7	24.2	23.3	23.3	24.9	25.7	24.5	23.2	24.5	25.7	22.7	23.1	24.2
1959	24.2	25.1	25.1	24.2	23.9	23.6	25.3	25.1	22.4	21.7	21.0	21.6	23.6
1960	24.5	24.4	23.8	24.9	25.4	25.8	24.9	23.1	22.1	21.6	22.1	22.7	23.8
1961	24.0	23.8	23.8	24.2	24.8	24.7	24.2	23.7	24.4	31.2	20.9	23.5	24.4
1962	23.0	24.0	24.1	23.2	25.0	25.3	22.9	23.0	22.9	24.6	22.2	21.9	23.5
1963	23.8	24.5	22.9	24.1	23.8	25.6	23.6	21.3	23.6	22.5	22.3	27.6	23.8
1964	26.5	25.6	24.5	22.0	22.5	23.4	24.5	26.1	24.0	22.6	22.6	23.8	24.0
1965	24.0	25.1	22.9	23.7	23.5	24.0	24.1	25.9	25.1	24.3	24.3	22.6	24.1
1966	23.4	23.7	23.0	23.9	22.3	25.7	23.3	22.5	22.6	23.9	22.8	22.3	23.3
1967	23.0	23.3	23.4	23.5	24.7	23.7	22.7	22.9	29.7	23.1	20.5	21.0	23.5
1968	22.8	24.0	25.1	23.4	24.2	25.5	24.3	23.7	26.1	24.0	23.0	24.9	24.3
1969	22.9	21.9	19.4	21.7	23.3	20.4	26.8	21.4	25.8	23.2	24.9	23.8	23.0
1970	23.7	20.7	22.7	20.6	21.8	21.7	19.5	19.3	20.3	20.5	21.0	22.5	21.2
1971	22.9	21.7	21.1	21.5	22.1	22.6	23.2	23.2	22.5	19.4	19.6	24.8	22.1
1972	21.4	23.8	26.8	24.0	21.7	22.6	22.6	22.2	19.7	19.5	18.6	17.8	21.7
1973	18.8	20.7	26.5	22.6	24.0	24.1	22.3	21.5	20.3	19.2	19.9	23.4	21.9
1974	20.9	19.3	22.6	22.0	21.0	21.3	20.0	20.9	22.9	20.6	19.5	20.0	20.9
1975	21.9	22.3	21.8	22.3	22.3	22.8	19.9	21.1	20.9	21.1	21.4	20.6	21.5
1976	21.3	20.7	22.1	21.9	20.6	22.6	21.3	19.0	18.3	20.0	22.0	22.1	21.0
1977	22.8	22.2	22.2	21.6	19.8	22.3	20.7	20.9	22.1	22.5	20.2	20.8	21.5
1978	22.5	22.6	21.4	21.0	23.0	25.4	23.8	25.8	22.6	21.9	23.4	19.7	22.8
1979	23.0	21.7	22.4	22.1	23.0	21.3	22.3	23.1	22.3	22.6	23.3	20.7	22.3
1980	22.0	20.6	22.7	24.4	21.7	22.1	22.7	20.1	19.4	18.0	19.3	20.7	21.1
1981	22.2	21.4	21.5	21.2	20.4	20.8	20.5	20.2	17.9	20.0	22.8	21.9	20.9
1982	22.7	21.0	21.0	21.4	21.3	20.0	19.7	22.0	22.3	20.1	22.3	23.4	21.4
1983	21.3	20.9	21.4	20.9	22.8	23.2	22.2	21.0	20.1	20.1	20.1	17.7	21.0
1984	21.0	21.8	19.7	19.4	21.0	21.0	22.3	21.7	23.3	21.6	21.8	23.5	21.5
1985	22.0	22.8	23.0	20.3	24.0	24.6	19.9	21.1	24.3	18.2	19.3	19.5	21.6
1986	22.4	23.1	24.4	23.6	21.5	21.7	21.7	22.1	22.1	21.5	20.5	22.4	22.3
1987	20.8	18.3	19.0	19.9	23.7	26.8	26.8	21.8	20.9	20.9	20.7	22.6	21.9
1988	21.4	20.9	21.8	23.2	23.3	22.1	20.2	22.1	18.7	19.5	21.0	21.5	21.3
1989	21.5	22.8	21.8	21.3	22.5	21.1	21.1	21.7	23.0	21.1	20.2	19.9	21.5
1990	19.3	21.8	22.4	22.4	23.3	23.4	23.5	23.9	24.4	18.8	19.7	20.5	22.0
1991	19.9	20.0	19.3	20.6	22.1	22.5	22.4	23.5	21.8	21.0	20.7	21.1	21.2
1992	21.8	22.1	22.5	22.9	22.7	21.8	21.3	21.8	20.5	20.2	20.5	21.9	21.7
1993	22.3	23.1	22.7	22.1	21.5	22.4	22.9	22.4	23.3	21.4	21.2	21.8	22.3
1994	23.0	22.7	22.5	21.3	21.5	23.6	22.1	21.3	21.4	21.0	20.5	20.9	21.8
1995	21.1	22.6	23.0	21.7	22.4	22.9	23.1	25.5	26.0	24.6	25.3	25.9	23.7
1996	25.9	25.5	25.0	25.0	25.0	25.0	24.4	24.4	23.0	23.5	23.2	24.0	24.5
1997	25.5	24.3	25.2	25.2	26.2	25.5	23.8	23.7	26.2	28.3	25.5	26.4	25.5
Mean													
1984-97	22.0	22.3	22.3	22.1	22.9	23.2	22.5	22.6	22.8	21.5	21.4	22.3	22.3
1969-80	22.0	21.5	22.6	22.1	22.0	22.4	22.1	21.5	21.4	20.7	21.1	21.4	21.8
1955-97	22.6	22.6	22.8	22.6	22.9	23.3	22.6	22.5	22.7	21.9	21.7	22.4	22.6

06402500
Beaver Creek near Buffalo Gap

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	4.9	6.3	10.7	11.1	9.8	9.3	2.9	0.9	3.3	0.6	18.3	8.2	7.2
1956	6.4	9.2	10.4	11.1	11.1	10.5	6.4	1.8	2.3	1.4	0.4	0.5	5.9
1957	1.6	5.2	11.9	12.4	10.8	8.4	3.4	9.4	16.6	7.7	2.2	4.1	7.8
1958	9.5	12.0	9.3	10.9	11.5	10.5	10.0	4.4	7.1	11.6	4.2	4.8	8.8
1959	6.7	8.0	10.9	11.0	9.4	8.0	1.7	0.9	0.7	3.3	1.5	1.6	5.3
1960	4.1	9.6	11.2	10.4	9.7	9.0	1.1	0.6	0.7	0.4	0.3	0.4	4.8
1961	0.7	4.5	10.3	10.9	9.0	4.3	1.0	1.0	2.4	0.4	0.3	1.0	3.8
1962	1.2	6.2	9.8	9.5	10.1	9.6	1.6	2.5	10.0	15.2	2.2	0.8	6.6
1963	9.3	11.3	8.4	9.1	8.6	9.3	7.8	5.6	25.9	11.7	3.7	5.8	9.7
1964	8.2	11.6	9.5	10.4	11.0	9.1	7.9	1.8	4.5	2.0	0.6	0.7	6.4
1965	1.6	9.0	11.3	11.7	11.7	10.6	7.2	9.3	9.6	6.6	2.5	6.6	8.1
1966	10.8	10.9	11.7	10.4	12.3	9.1	5.6	1.6	0.4	8.7	3.1	7.0	7.6
1967	7.1	8.3	10.8	10.9	10.7	9.9	0.8	3.4	14.4	6.1	3.5	5.9	7.6
1968	9.4	9.6	10.5	11.5	11.1	6.2	2.5	2.7	7.8	3.7	1.1	5.3	6.8
1969	6.7	9.0	9.1	10.8	10.4	9.0	2.3	0.9	0.7	6.1	2.4	1.1	5.7
1970	10.1	8.1	7.7	8.5	9.5	11.3	8.4	5.0	1.8	1.0	1.2	6.1	6.6
1971	10.0	7.9	8.2	10.2	13.5	10.6	9.8	9.4	10.3	6.0	0.8	7.1	8.6
1972	9.2	11.0	11.1	8.0	9.5	9.1	4.7	4.6	13.3	4.1	3.5	6.0	7.8
1973	9.3	9.2	7.0	9.4	11.1	9.4	8.4	4.8	0.8	1.5	2.3	6.4	6.6
1974	8.1	7.2	8.7	10.0	11.9	7.5	8.0	3.0	0.4	0.3	0.3	0.6	5.5
1975	2.8	7.6	9.2	9.3	9.5	9.7	6.6	2.8	6.4	12.8	3.3	5.8	7.1
1976	1.9	5.9	7.2	10.0	10.3	10.1	7.1	4.3	2.6	4.7	7.5	3.5	6.3
1977	5.6	7.7	9.6	9.6	10.0	7.2	6.5	5.0	1.8	0.5	4.6	5.4	6.1
1978	6.5	12.4	11.8	11.5	9.9	16.1	3.8	7.1	4.6	1.2	1.5	4.6	7.6
1979	7.4	9.2	12.5	12.2	11.6	11.5	7.0	1.5	0.8	1.4	12.2	7.6	7.9
1980	7.7	11.0	8.8	10.4	11.3	10.8	7.9	1.1	0.7	0.3	0.4	0.6	5.9
1981	3.9	11.0	9.1	9.3	10.1	7.5	1.2	4.4	3.3	4.1	7.4	6.9	6.5
1982	5.9	9.1	11.2	9.8	10.8	10.8	6.0	7.4	12.1	7.1	8.0	8.6	8.9
1983	9.7	10.0	8.4	8.2	7.9	7.4	4.8	5.5	5.5	2.0	1.4	2.9	6.1
1984	5.6	9.1	8.9	11.1	9.5	8.6	9.3	9.7	10.3	10.3	4.8	7.6	8.7
1985	10.5	10.9	11.0	7.1	7.1	8.1	5.0	0.8	0.5	0.7	5.5	9.7	6.4
1986	9.8	9.1	10.3	10.7	10.2	8.9	12.8	5.1	8.8	5.9	3.4	9.8	8.7
1987	9.9	10.0	8.9	8.3	9.4	10.8	10.5	7.9	10.2	4.7	4.3	7.6	8.5
1988	9.1	9.0	9.9	11.2	9.9	8.2	3.1	1.0	0.6	0.3	2.8	6.3	5.9
1989	7.3	8.5	8.5	9.8	9.2	9.3	6.3	3.1	1.5	1.5	2.5	4.6	6.0
1990	4.8	7.7	7.9	9.3	8.9	8.7	7.7	1.9	8.1	2.2	3.2	1.2	6.0
1991	4.1	8.1	6.0	8.5	10.0	8.7	8.7	5.8	10.0	7.5	2.9	4.2	7.0
1992	9.4	7.6	8.6	8.3	8.2	8.4	10.3	1.7	8.0	7.3	4.2	8.0	7.5
1993	7.4	9.5	8.3	8.5	9.0	9.8	9.1	6.9	6.3	5.7	6.0	10.6	8.1
1994	11.5	9.8	8.5	8.4	8.1	8.6	7.1	1.9	1.1	0.8	0.5	5.2	6.0
1995	3.3	5.5	8.3	9.0	8.7	8.1	8.9	10.6	42.7	26.4	8.5	10.7	12.6
1996	11.6	11.0	10.1	9.8	9.6	9.9	10.7	9.0	11.0	7.0	7.5	9.3	9.7
1997	9.0	9.9	9.8	10.5	10.7	9.6	9.1	9.9	10.8	13.6	12.3	10.9	10.5
Mean													
1984-97	8.1	9.0	8.9	9.3	9.2	9.0	8.5	5.4	9.3	6.7	4.9	7.6	8.0
1969-80	7.1	8.9	9.2	10.0	10.7	10.2	6.7	4.1	3.7	3.3	3.3	4.6	6.8
1955-97	7.0	8.9	9.6	10.0	10.1	9.2	6.3	4.4	7.0	5.3	3.9	5.4	7.2

Beaver Creek return flow

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1956	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1957	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1958	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1959	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1960	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1961	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1962	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1963	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1964	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1965	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1966	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1967	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1968	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1969	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1970	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1971	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1972	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1973	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1974	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1975	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1976	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1977	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1978	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1979	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1980	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1981	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1982	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1983	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1984	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1985	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1986	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1987	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1988	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1989	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1990	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1991	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1992	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1993	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1994	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1995	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1996	2	2	2	2	2	2	2	2	2	2	2	2	2.0
1997	2	2	2	2	2	2	2	2	2	2	2	2	2.0
Mean													
1984-97	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
1969-80	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
1955-97	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

0640000 Hat Creek
Hat Creek near Edgemont

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	0.0	0.0	0.2	0.1	0.0	80.3	98.1	29.9	17.8	0.0	68.4	70.1	30.4
1956	2.4	0.7	16.0	3.7	3.3	10.6	0.8	20.4	19.5	10.0	6.4	0.0	7.8
1957	0.0	1.9	2.4	0.5	5.9	9.5	55.3	443.5	105.7	21.8	1.4	1.6	54.1
1958	3.0	2.2	1.8	2.2	3.8	13.6	29.2	0.9	17.0	105.9	4.0	0.0	15.3
1959	0.0	0.0	0.0	1.5	0.5	37.6	0.5	11.1	21.9	40.2	0.2	3.8	9.8
1960	0.5	0.3	0.6	0.3	0.8	21.5	2.8	5.3	0.7	0.0	0.0	0.0	2.7
1961	0.0	0.0	0.0	0.0	0.0	6.1	0.4	0.5	0.2	6.3	2.0	0.0	1.3
1962	0.0	0.0	0.0	0.0	0.0	10.7	0.4	73.7	134.3	40.7	2.5	0.0	21.9
1963	0.2	0.0	0.0	0.0	23.1	34.0	3.7	3.1	72.6	3.9	0.1	1.8	11.9
1964	0.9	0.1	0.0	0.1	0.1	0.7	11.9	3.5	52.5	0.5	0.0	0.0	5.9
1965	0.0	0.0	0.0	0.0	0.0	0.2	0.8	92.0	58.6	63.4	1.3	2.6	18.3
1966	6.6	1.7	0.8	1.4	1.5	95.7	15.6	1.2	0.2	12.9	44.9	0.2	15.2
1967	6.3	1.0	0.3	0.2	1.6	0.5	27.2	29.2	1223.0	70.6	3.9	1.1	113.8
1968	1.8	6.7	3.5	4.5	11.4	5.1	140.7	50.0	272.1	90.6	31.5	1.8	51.6
1969	3.7	2.4	2.7	2.2	2.8	32.6	8.3	1.8	1.6	45.4	0.9	0.0	8.7
1970	0.6	1.9	1.2	0.2	1.3	1.2	14.9	0.4	14.4	0.0	0.4	0.0	3.0
1971	0.0	0.0	0.0	0.0	2.8	3.7	7.1	224.4	132.0	4.2	0.0	1.0	31.3
1972	1.3	2.7	0.9	0.7	6.5	11.5	1.5	2.7	7.0	3.5	0.0	0.0	3.2
1973	0.0	0.0	0.0	0.4	0.4	24.6	57.2	64.4	0.3	8.2	0.0	7.8	13.6
1974	0.3	0.9	1.0	25.5	24.2	7.8	86.9	1.1	0.1	0.0	0.0	0.0	12.3
1975	0.0	0.0	0.0	0.0	0.0	0.1	6.4	2.4	2.2	4.0	0.0	0.0	1.3
1976	0.0	0.0	0.0	0.0	3.6	0.5	0.3	25.0	42.0	1.0	0.3	0.0	6.1
1977	0.0	0.0	0.0	0.0	0.0	0.3	3.9	0.4	2.8	0.0	0.0	0.0	0.6
1978	0.1	0.0	0.0	0.0	0.0	119.3	2.0	69.6	1.9	1.4	0.7	0.0	16.3
1979	0.0	0.0	0.0	0.0	0.0	9.7	2.9	1.1	0.8	0.6	17.9	0.0	2.7
1980	0.0	0.0	0.0	0.1	52.6	15.2	10.0	0.5	0.1	0.0	0.2	0.0	6.6
1981	0.0	0.0	0.3	0.4	0.1	0.1	0.0	1.5	0.9	0.2	0.0	0.0	0.3
1982	0.0	0.0	0.0	0.0	0.0	0.1	0.1	82.2	172.5	4.8	37.5	2.6	25.0
1983	4.4	3.4	3.9	6.1	3.5	3.2	13.4	45.7	7.4	5.8	12.4	0.4	9.1
1984	0.1	1.3	1.0	5.1	10.1	2.3	20.3	116.3	103.5	10.0	2.0	0.0	22.7
1985	0.7	2.4	1.5	1.5	1.3	5.8	1.7	0.6	1.9	0.4	0.0	0.0	1.5
1986	0.7	0.0	0.2	0.4	15.5	103.4	90.9	33.2	206.4	29.0	2.6	0.6	40.2
1987	13.0	6.5	5.1	5.9	10.4	67.0	15.2	15.4	13.5	0.8	0.0	0.0	12.7
1988	0.1	1.7	1.1	0.8	2.1	4.9	0.3	6.4	1.6	0.0	0.6	0.0	1.6
1989	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.2	0.0	0.0	1.0	0.2
1990	0.0	0.0	0.0	0.0	0.1	0.4	0.1	0.7	0.4	1.6	0.0	0.0	0.3
1991	0.0	0.0	0.0	0.0	0.1	0.3	6.3	358.2	141.4	3.8	2.7	0.0	42.7
1992	0.0	0.7	0.6	0.5	0.9	0.6	0.5	0.5	1.0	2.4	0.2	0.0	0.7
1993	0.0	0.3	0.3	0.2	0.2	149.6	106.6	12.2	64.7	71.3	2.9	0.7	34.1
1994	4.1	3.6	4.2	2.9	4.0	20.1	14.7	7.3	8.3	4.6	0.0	0.0	6.1
1995	1.1	0.0	0.1	2.7	10.5	2.7	13.9	50.9	56.1	0.2	0.0	0.0	11.5
1996	0.7	0.7	1.1	1.1	0.3	1.1	10.2	82.4	31.4	4.0	0.0	0.0	11.1
1997	0.9	5.0	1.4	22.2	26.5	4.9	16.8	46.1	158.8	48.0	11.5	2.6	28.7
Mean													
1984-97	1.5	1.6	1.2	3.1	5.9	25.9	21.3	52.2	56.4	12.6	1.6	0.4	15.3
1969-80	0.5	0.7	0.5	2.4	7.9	18.9	16.8	32.8	17.1	5.7	1.7	0.7	8.8
1955-97	1.2	1.1	1.2	2.2	5.4	21.4	20.9	46.9	73.8	16.8	6.0	2.3	16.6

Ungaged Tributary - Hat Creek * .49

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	0.00	0.01	0.10	0.03	0.00	39.35	48.07	14.65	8.72	0.00	33.52	34.35	14.90
1956	1.18	0.34	7.84	1.80	1.60	5.19	0.39	10.00	9.56	4.90	3.15	0.00	3.83
1957	0.00	0.91	1.18	0.23	2.89	4.64	27.10	217.32	51.79	10.68	0.70	0.77	26.52
1958	1.45	1.06	0.90	1.08	1.84	6.66	14.31	0.43	8.33	51.89	1.95	0.00	7.49
1959	0.00	0.00	0.01	0.75	0.26	18.42	0.22	5.44	10.73	19.70	0.10	1.85	4.79
1960	0.24	0.16	0.31	0.16	0.39	10.54	1.35	2.61	0.35	0.00	0.00	0.00	1.34
1961	0.00	0.00	0.00	0.00	0.01	2.96	0.18	0.23	0.10	3.10	0.99	0.00	0.63
1962	0.00	0.00	0.00	0.00	0.01	5.24	0.18	36.11	65.81	19.94	1.23	0.00	10.71
1963	0.11	0.01	0.00	0.01	11.32	16.66	1.82	1.53	35.57	1.91	0.07	0.90	5.83
1964	0.46	0.04	0.02	0.07	0.04	0.36	5.83	1.71	25.73	0.23	0.00	0.00	2.87
1965	0.00	0.00	0.00	0.00	0.02	0.10	0.40	45.08	28.71	31.07	0.65	1.29	8.94
1966	3.23	0.81	0.37	0.70	0.73	46.89	7.64	0.59	0.07	6.32	22.00	0.11	7.46
1967	3.11	0.50	0.15	0.12	0.78	0.22	13.33	14.31	599.27	34.59	1.93	0.55	55.74
1968	0.86	3.30	1.72	2.21	5.59	2.51	68.94	24.50	133.33	44.39	15.44	0.89	25.31
1969	1.81	1.19	1.30	1.10	1.38	15.97	4.08	0.90	0.78	22.25	0.45	0.00	4.27
1970	0.28	0.91	0.61	0.09	0.63	0.59	7.30	0.22	7.06	0.00	0.17	0.00	1.49
1971	0.00	0.00	0.00	0.00	1.35	1.80	3.46	109.96	64.68	2.07	0.00	0.48	15.32
1972	0.64	1.31	0.44	0.33	3.20	5.64	0.75	1.32	3.43	1.71	0.00	0.00	1.56
1973	0.00	0.00	0.00	0.21	0.22	12.05	28.03	31.56	0.16	3.99	0.01	3.84	6.67
1974	0.14	0.44	0.48	12.50	11.86	3.82	42.58	0.52	0.04	0.00	0.00	0.00	6.03
1975	0.00	0.00	0.00	0.00	0.00	0.06	3.15	1.18	1.10	1.97	0.00	0.00	0.62
1976	0.00	0.00	0.00	0.00	1.76	0.26	0.17	12.25	20.58	0.50	0.12	0.00	2.97
1977	0.00	0.00	0.00	0.00	0.00	0.13	1.89	0.21	1.39	0.01	0.00	0.00	0.30
1978	0.05	0.00	0.01	0.00	0.01	58.46	0.99	34.10	0.94	0.68	0.32	0.00	7.96
1979	0.00	0.00	0.00	0.00	0.00	4.73	1.40	0.52	0.40	0.29	8.77	0.00	1.34
1980	0.00	0.00	0.00	0.04	25.77	7.45	4.90	0.25	0.03	0.00	0.11	0.00	3.21
1981	0.00	0.00	0.13	0.19	0.06	0.05	0.02	0.75	0.46	0.09	0.00	0.00	0.14
1982	0.00	0.00	0.00	0.00	0.00	0.07	0.04	40.28	84.53	2.36	18.38	1.28	12.24
1983	2.16	1.68	1.91	3.01	1.70	1.57	6.57	22.39	3.63	2.84	6.08	0.20	4.48
1984	0.07	0.62	0.51	2.48	4.95	1.13	9.95	56.99	50.72	4.89	0.96	0.00	11.10
1985	0.35	1.15	0.72	0.74	0.63	2.83	0.84	0.29	0.92	0.20	0.00	0.00	0.72
1986	0.35	0.00	0.10	0.19	7.60	50.67	44.54	16.27	101.14	14.21	1.25	0.32	19.72
1987	6.37	3.19	2.51	2.89	5.10	32.83	7.45	7.55	6.62	0.40	0.00	0.00	6.24
1988	0.05	0.81	0.53	0.39	1.02	2.42	0.15	3.13	0.80	0.01	0.31	0.00	0.80
1989	0.00	0.00	0.00	0.00	0.00	0.07	0.18	0.10	0.11	0.00	0.00	0.49	0.08
1990	0.00	0.00	0.00	0.01	0.03	0.17	0.06	0.36	0.22	0.79	0.01	0.00	0.14
1991	0.00	0.00	0.00	0.00	0.05	0.13	3.07	175.52	69.29	1.86	1.34	0.00	20.94
1992	0.02	0.33	0.29	0.26	0.43	0.29	0.23	0.26	0.49	1.16	0.10	0.00	0.32
1993	0.00	0.16	0.12	0.08	0.09	73.30	52.23	5.98	31.70	34.94	1.42	0.34	16.70
1994	2.01	1.75	2.03	1.42	1.98	9.85	7.20	3.58	4.04	2.27	0.01	0.00	3.01
1995	0.51	0.00	0.04	1.31	5.15	1.31	6.81	24.94	27.49	0.09	0.00	0.00	5.64
1996	0.34	0.36	0.51	0.52	0.14	0.52	5.00	40.38	15.39	1.94	0.00	0.00	5.42
1997	0.46	2.44	0.67	10.88	12.99	2.40	8.23	22.59	77.81	23.52	5.64	1.26	14.07
Mean													
1984-97	0.8	0.8	0.6	1.5	2.9	12.7	10.4	25.6	27.6	6.2	0.8	0.2	7.5
1969-80	0.2	0.3	0.2	1.2	3.8	9.2	8.2	16.1	8.4	2.8	0.8	0.4	4.3
1955-97	0.6	0.5	0.6	1.1	2.6	10.5	10.3	23.0	36.1	8.2	3.0	1.1	8.1

06402600
Cheyenne River near Buffalo Gap (cfs)

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1969	66.8	67.5	55.6	45.5	62.0	88.0	66.5	51.6	52.8	866.3	61.4	76.3	130.0
1970	75.4	64.4	77.4	71.6	77.8	65.5	77.8	60.3	58.3	51.5	64.2	75.9	68.3
1971	83.7	62.6	52.6	52.9	81.9	70.4	74.5	1403.0	1069.0	51.6	56.3	91.1	262.5
1972	76.8	72.9	73.5	55.0	59.2	57.5	58.6	68.9	130.8	56.5	78.1	76.7	72.0
1973	67.0	70.5	67.6	65.3	69.1	71.5	74.0	171.3	50.9	62.7	50.3	95.4	76.3
1974	73.6	84.1	40.2	98.3	235.4	135.1	190.3	59.3	44.3	36.9	57.6	60.3	93.0
1975	63.1	69.5	59.2	61.6	60.5	67.4	53.8	60.5	62.8	48.8	45.2	58.5	59.2
1976	63.7	63.9	62.5	44.1	58.1	59.5	64.2	58.8	49.1	32.6	66.3	55.6	56.5
1977	67.0	64.1	69.5	61.3	64.9	59.0	61.5	51.6	32.3	70.1	43.9	68.5	59.5
1978	75.2	70.9	34.7	39.7	54.9	109.3	45.6	1909.0	197.7	139.8	146.9	61.0	240.4
1979	68.5	77.6	73.7	56.8	63.8	262.6	181.5	59.6	58.7	63.2	71.5	60.6	91.5
1980	68.5	73.6	71.9	62.6	134.7	161.5	101.6	50.6	56.1	20.7	49.2	64.1	76.3
Mean	70.8	70.1	61.5	59.6	85.2	100.6	87.5	333.7	155.2	125.1	65.9	70.3	107.1
Min	63.1	62.6	34.7	39.7	54.9	57.5	45.6	50.6	32.3	20.7	43.9	55.6	56.5
10 pctile	63.2	62.7	35.3	40.1	55.2	57.7	46.4	51.6	33.5	33.0	44.0	55.9	56.8
25 pctile	67.0	64.3	54.9	51.1	60.2	64.0	60.8	57.0	50.5	45.8	50.0	60.5	66.1
Median	68.5	70.0	65.1	59.1	64.4	71.0	70.3	60.0	57.2	54.1	59.5	66.3	76.3
75 pctile	75.3	73.1	72.3	63.3	78.8	115.8	83.8	94.5	79.8	64.9	67.6	76.4	102.2
90 pctile	76.8	77.6	73.7	71.6	134.7	161.5	181.5	1403.0	197.7	70.1	78.1	91.1	240.4
Max	83.7	84.1	77.4	98.3	235.4	262.6	190.3	1909.0	1069.0	866.3	146.9	95.4	262.5
STD	5.9	6.1	13.1	14.7	49.7	58.3	46.0	601.1	279.1	225.3	26.4	12.4	67.5

Cheyenne River at Buffalo Gap Natural Flow (cfs)
Oct. 68 - Sept. 80 = Qn=Qh+S+EA+seep(EA*1.5)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Average
1969	70.8	105.3	78.8	70.6	93.7	247.7	142.0	62.5	71.6	1035.2	-119.0	-45.2	151.2
1970	88.1	102.8	108.1	93.4	146.2	185.3	221.5	138.5	54.2	-164.3	-128.1	8.1	71.2
1971	127.3	101.4	78.3	74.8	163.2	208.2	473.7	1499.7	1091.1	-112.3	-162.5	57.8	300.1
1972	132.8	130.4	103.8	77.8	174.4	382.0	111.9	99.3	202.6	-120.8	-75.3	13.4	102.7
1973	105.2	114.8	92.1	94.6	113.3	177.3	209.8	387.5	4.5	-27.6	-115.6	347.2	125.3
1974	141.6	147.6	79.7	185.7	253.2	197.4	236.6	-37.1	-78.5	-188.1	-70.7	41.6	75.7
1975	102.3	123.0	82.7	86.1	85.7	248.3	317.1	85.6	163.6	-95.5	-173.1	-20.1	83.8
1976	98.6	93.3	100.9	72.3	115.1	166.7	132.8	79.5	265.6	-109.6	-21.1	-16.6	81.5
1977	100.8	92.9	88.9	82.8	96.9	135.1	187.0	25.9	-10.5	-38.7	-71.2	55.7	62.1
1978	132.3	103.8	62.8	65.5	82.0	908.5	145.6	2023.6	220.8	224.3	138.6	7.3	342.9
1979	87.4	112.8	106.8	86.5	89.3	340.7	200.6	51.7	72.1	39.3	256.4	-9.3	119.5
1980	73.0	110.2	92.7	90.0	265.8	179.7	111.2	12.1	79.0	-234.5	-58.2	-2.9	59.8
Mean	105.0	111.5	89.6	90.0	139.9	281.4	207.5	369.1	178.0	17.3	-50.0	36.4	131.3
Min	70.8	92.9	62.8	65.5	82.0	135.1	111.2	-37.1	-78.5	-234.5	-173.1	-45.2	59.8
10 pctile	74.4	94.1	78.4	70.8	86.0	167.7	114.0	13.5	-9.0	-185.8	-159.0	-19.7	63.0
25 pctile	87.9	102.4	79.4	74.2	92.6	179.1	139.7	45.3	41.8	-131.6	-121.3	-11.1	74.6
Median	101.5	107.8	90.5	84.5	114.2	202.8	193.8	82.6	75.5	-102.5	-73.3	7.7	93.3
75 pctile	128.5	116.8	101.7	90.8	166.0	271.4	225.3	200.7	207.1	-10.9	-49.0	45.1	131.7
90 pctile	132.8	129.7	106.5	94.5	245.3	377.9	309.1	1388.5	261.2	205.8	122.6	57.6	285.2
Max	141.6	147.6	108.1	185.7	265.8	908.5	473.7	2023.6	1091.1	1035.2	256.4	347.2	342.9

Total Buffalo Gap In (Res inflow+Fall R.+Beaver Cr.+Beaver Cr. Return+ungaged Tribs)

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	51.6	45.5	52.5	55.5	64.5	322.8	921.5	348.4	309.3	70.0	528.8	328.2	258.2
1956	47.4	49.7	113.1	86.6	89.8	185.6	71.1	194.7	215.1	18.3	65.6	21.9	96.6
1957	33.1	59.0	65.4	61.1	80.7	129.5	168.6	1569.1	670.1	171.5	155.4	68.5	269.3
1958	68.6	74.6	51.8	56.8	81.7	135.9	237.3	57.7	156.2	987.3	305.7	21.5	186.3
1959	41.0	43.5	54.3	55.9	51.8	157.8	62.8	66.0	230.7	173.6	23.0	48.8	84.1
1960	50.3	58.0	60.1	62.4	69.9	203.5	57.9	52.7	115.9	45.1	30.9	36.8	70.3
1961	39.7	48.8	58.9	60.2	59.3	63.3	45.8	51.3	52.4	103.4	63.2	34.9	56.8
1962	47.4	52.4	52.1	54.3	146.9	160.9	45.2	2143.7	2932.4	1431.1	146.4	28.1	603.4
1963	80.7	56.3	52.8	58.9	207.8	182.0	124.2	186.5	823.2	129.2	39.4	143.9	173.7
1964	43.7	44.3	45.8	53.8	64.3	85.2	144.4	112.9	496.6	82.1	8.9	28.2	100.9
1965	32.4	54.5	59.0	67.8	75.0	132.7	136.3	516.5	1031.8	374.6	68.5	59.3	217.4
1966	107.7	62.6	59.8	61.8	73.3	356.9	142.8	34.9	15.0	265.4	344.2	49.8	131.2
1967	104.5	72.8	60.7	74.9	126.4	235.8	136.3	234.5	2532.6	379.7	36.0	58.0	337.7
1968	39.9	72.5	68.6	72.4	98.7	166.3	178.4	108.2	673.4	153.8	144.0	75.1	154.3
1969	48.0	62.7	54.5	61.6	69.5	227.9	122.5	137.5	131.8	969.2	44.4	25.2	162.9
1970	54.0	60.2	63.9	53.8	102.3	155.9	164.9	129.0	9.3	34.9	48.8	25.5	75.2
1971	64.2	61.9	57.3	56.3	120.0	175.2	421.6	1536.7	1065.8	58.7	32.1	56.2	308.8
1972	75.5	86.8	71.2	57.9	151.7	364.6	75.5	80.6	144.3	59.8	69.6	34.2	106.0
1973	64.2	67.2	59.9	64.4	82.3	153.3	181.7	414.4	75.4	158.4	51.9	311.2	140.4
1974	83.2	82.7	72.8	196.7	216.0	150.1	208.7	23.2	15.2	35.9	57.6	34.4	98.0
1975	49.4	77.3	55.8	58.9	59.0	215.1	280.4	101.9	158.1	81.8	43.0	16.6	99.8
1976	43.1	50.5	70.3	63.1	92.3	142.3	86.0	99.3	287.2	82.5	85.3	41.1	95.2
1977	48.2	52.1	54.9	55.5	64.2	108.1	140.4	50.8	69.3	86.8	65.8	97.1	74.4
1978	73.4	62.2	62.9	61.2	61.9	902.1	114.6	2604.5	369.6	533.2	329.7	46.5	435.1
1979	61.6	58.1	69.4	67.0	61.8	296.5	189.0	82.4	89.4	182.4	365.0	43.8	130.5
1980	49.6	60.5	54.6	65.1	280.4	205.0	116.5	52.8	102.8	12.2	103.1	25.0	94.0
1981	49.3	59.6	71.7	74.6	77.6	61.2	35.5	64.7	35.4	239.3	183.5	-11.3	78.4
1982	66.3	59.0	58.6	58.3	104.3	128.8	68.1	357.9	830.1	160.1	211.6	129.4	186.0
1983	140.8	81.6	67.9	83.5	185.6	138.2	133.1	192.4	120.3	80.6	104.3	24.5	112.7
1984	74.2	72.2	60.4	71.9	185.1	358.0	193.1	703.5	360.2	63.2	68.6	51.6	188.5
1985	69.0	73.8	61.1	59.2	64.4	174.1	68.1	21.0	29.4	73.1	83.7	56.4	69.4
1986	65.4	59.4	61.2	65.6	192.5	484.9	434.0	256.8	839.9	177.0	35.3	172.3	237.0
1987	257.0	75.5	63.3	73.7	171.6	605.9	243.4	188.9	162.4	34.5	41.6	50.6	164.0
1988	50.5	66.3	63.5	58.8	72.3	109.5	54.1	67.2	35.5	54.3	65.1	56.7	62.8
1989	47.1	58.5	58.3	56.1	60.7	113.8	68.2	74.1	36.7	52.3	37.7	131.2	66.2
1990	52.1	66.8	63.2	66.3	73.8	153.0	95.5	125.7	63.3	79.1	62.3	45.6	78.9
1991	56.9	62.0	53.3	57.5	77.3	83.8	74.9	1857.5	1585.3	86.0	33.4	42.5	339.2
1992	54.4	72.3	62.7	64.6	87.4	86.1	60.7	46.9	69.6	92.4	56.1	50.4	67.0
1993	51.2	59.9	57.5	59.8	63.2	535.2	371.9	237.3	397.7	356.8	180.3	68.4	203.3
1994	84.0	58.1	64.3	79.7	172.2	652.3	103.9	80.9	38.7	45.6	55.6	41.6	123.1
1995	82.2	57.0	70.7	84.2	140.9	122.2	104.7	388.3	530.1	97.0	57.0	55.4	149.1
1996	74.0	89.3	65.3	71.2	135.8	268.3	205.1	477.4	288.3	24.7	91.3	79.0	155.8
1997	80.9	89.0	76.7	134.0	748.7	708.0	427.9	420.9	609.2	236.6	156.0	60.7	312.4
Mean													
1984-97	78.5	68.6	63.0	71.6	160.4	318.2	179.0	353.3	360.5	105.2	73.1	68.7	158.3
1969-80	59.5	65.2	62.3	71.8	113.5	258.0	175.2	442.8	209.9	191.3	108.0	63.1	151.7
1955-97	66.5	63.7	62.4	68.9	122.4	241.8	170.2	384.9	437.3	200.8	111.2	66.6	166.4

Angostura Reservoir monthly change in EOM content, HYDROMET RES070 (cfs)

EOM Content in cfs = Change in Content (AF) divided by 1.98347 divided by days in a month.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	-3.4	8.3	13.8	19.1	28.5	245.2	693.1	3.9	-11.4	-248.0	188.0	73.4	84.2
1956	-74.2	-80.9	-16.7	-41.3	-40.5	56.1	-66.4	-22.9	-40.9	-313.2	-234.4	-203.5	-89.9
1957	-67.8	24.2	29.7	25.5	43.1	93.2	106.4	818.8	-33.2	-147.7	-157.7	-120.0	51.2
1958	-16.1	-2.9	-34.6	-38.2	-15.8	36.8	176.0	-101.7	-52.4	460.6	-225.0	-219.2	-2.7
1959	-114.5	-45.3	-39.9	-35.3	-41.6	105.7	23.9	-32.9	-41.0	-119.9	-328.3	-118.4	-65.6
1960	10.0	17.1	22.8	24.9	32.2	155.7	20.6	-22.8	-14.0	-235.4	-169.4	-61.8	-18.3
1961	8.4	14.8	22.5	23.1	23.6	29.0	12.2	16.2	8.5	-74.6	-47.9	-2.8	2.8
1962	12.2	15.5	16.5	19.6	109.0	118.0	9.1	1194.3	-33.5	-1.6	-191.1	-148.9	93.3
1963	25.5	11.3	19.1	23.6	161.3	108.8	5.7	-4.7	3.2	-154.8	-235.9	14.8	-1.8
1964	-10.0	-2.2	10.0	19.3	29.6	51.1	84.6	-22.5	226.1	-233.7	-285.9	-97.5	-19.3
1965	-23.8	11.6	23.2	30.4	37.4	96.7	92.5	354.6	3.2	0.0	-211.5	-79.8	27.9
1966	28.8	17.6	22.4	24.8	35.2	161.5	0.8	-85.8	-192.8	29.6	109.3	-109.1	3.5
1967	-314.3	32.6	24.9	38.4	87.8	29.1	-8.0	7.0	14.5	-38.6	-256.5	-123.2	-42.2
1968	-47.7	27.3	30.0	33.3	55.9	130.5	69.1	-25.2	146.0	-139.8	-115.1	-71.1	7.8
1969	-29.4	21.9	23.2	25.9	31.7	159.7	48.6	-20.5	-25.1	97.7	-251.2	-165.7	-6.9
1970	-20.0	22.7	30.7	22.6	68.4	119.8	117.2	46.5	-48.8	-284.0	-255.7	-107.1	-24.0
1971	14.5	24.7	25.7	22.6	81.3	137.8	373.4	64.7	-23.3	-233.8	-284.3	-74.5	10.7
1972	25.2	42.5	30.3	23.5	115.2	324.5	25.9	-1.5	26.4	-247.2	-219.5	-104.2	3.4
1973	7.1	29.2	24.5	30.3	44.2	105.8	110.5	185.7	-90.4	-158.2	-231.1	208.5	22.2
1974	34.2	47.2	39.5	90.4	18.2	62.4	19.1	-127.7	-164.9	-288.3	-186.6	-55.1	-42.6
1975	12.0	40.3	23.5	25.3	25.2	180.9	238.9	-4.2	59.3	-209.7	-279.0	-115.0	-0.2
1976	7.9	16.4	38.4	29.2	57.0	107.2	45.5	-6.4	177.3	-204.7	-146.3	-109.0	1.0
1977	6.7	15.8	20.4	22.3	32.0	76.1	99.9	-52.2	-78.9	-163.6	-167.0	-46.1	-19.5
1978	31.9	20.7	28.1	26.6	27.1	799.5	73.4	82.8	-22.5	11.7	-81.0	-100.4	74.8
1979	-15.8	18.5	33.1	30.7	25.6	77.7	-8.0	-39.6	-30.7	-93.1	114.4	-116.8	-0.3
1980	-30.1	20.0	20.8	28.3	130.8	17.7	-18.3	-69.9	-20.7	-322.0	-170.0	-106.2	-43.3
1981	9.0	18.9	38.6	42.0	44.7	30.8	-22.6	-23.7	-116.7	-55.2	-151.1	-198.1	-31.9
1982	25.4	22.9	25.0	25.1	69.6	96.5	31.3	276.2	396.0	-136.2	-95.7	-65.4	55.9
1983	90.9	40.4	22.6	23.5	110.4	14.1	9.3	-13.4	3.8	-194.1	-169.4	-142.5	-17.0
1984	33.8	32.8	28.9	36.9	148.2	237.5	8.5	-1.5	-10.0	-211.8	-241.4	-129.7	-5.7
1985	22.2	30.8	24.7	29.0	30.1	136.0	15.9	-126.5	-131.5	-224.6	-178.1	-65.5	-36.5
1986	21.3	20.8	23.8	29.1	150.8	402.3	343.5	36.8	20.0	-128.9	-215.7	54.4	63.2
1987	178.8	-5.2	-18.5	40.6	89.0	15.6	2.3	-0.7	-50.4	-247.3	-239.0	-61.1	-24.7
1988	3.0	22.3	26.6	20.3	35.0	72.2	-28.4	-39.1	-107.3	-231.1	-171.0	-64.5	-38.5
1989	5.6	18.7	24.0	21.2	25.2	78.7	30.2	3.6	-66.3	-124.0	-146.2	58.3	-5.9
1990	13.7	25.8	26.0	25.9	35.3	115.3	49.9	69.3	-21.0	-152.7	-133.9	-39.2	1.2
1991	14.4	21.1	20.5	21.6	37.8	45.7	26.4	949.7	-17.0	-156.2	-205.6	-116.0	53.5
1992	5.7	32.0	27.5	29.4	52.3	51.4	16.7	-66.3	-11.6	-106.7	-214.6	-109.4	-24.5
1993	8.6	19.6	24.2	27.1	30.7	428.0	248.3	-38.5	27.5	-17.0	-65.6	-82.0	50.9
1994	14.0	-34.6	0.7	45.6	136.6	0.7	23.8	-69.2	-129.7	-236.3	-230.1	-60.0	-44.9
1995	38.1	15.9	32.9	45.6	97.6	85.3	46.9	298.5	72.2	-196.6	-270.5	-126.5	11.6
1996	20.9	44.5	27.1	33.6	99.3	230.6	147.4	16.4	-62.0	-298.2	-211.2	-45.1	0.3
1997	22.6	33.6	31.2	77.1	489.0	-6.0	3.8	0.0	-13.8	-45.6	-41.9	-112.6	36.5
Mean													
1984-97	28.8	19.9	21.4	34.5	104.0	135.2	66.8	73.8	-35.8	-169.8	-183.2	-64.2	2.6
1969-80	3.7	26.7	28.2	31.5	54.7	180.8	93.8	4.8	-20.2	-174.6	-179.8	-74.3	-2.1
1955-97	-0.3	17.0	20.2	26.0	67.1	130.7	76.7	79.2	-11.1	-141.3	-169.8	-80.5	1.2

Angostura Reservoir monthly historic evaporation (cfs)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	11.1	5.3	0.0	0.0	0.0	0.0	10.4	13.2	18.6	29.0	29.1	20.0	11.4
1956	15.1	7.1	0.0	0.0	0.0	0.0	10.8	12.4	17.3	26.4	24.3	14.8	10.7
1957	10.5	5.0	0.0	0.0	0.0	0.0	8.7	11.8	18.6	29.2	28.5	18.3	10.9
1958	13.6	6.5	0.0	0.0	0.0	0.0	10.2	11.9	16.5	28.0	29.2	18.4	11.2
1959	13.2	6.2	0.0	0.0	0.0	0.0	9.6	11.1	15.4	24.0	22.0	13.1	9.5
1960	9.7	4.7	0.0	0.0	0.0	0.0	8.2	9.6	13.3	20.2	18.4	11.5	8.0
1961	8.6	4.1	0.0	0.0	0.0	0.0	6.8	8.0	11.4	17.9	17.6	11.5	7.2
1962	8.7	4.2	0.0	0.0	0.0	0.0	7.5	11.1	18.7	29.9	29.7	18.9	10.7
1963	14.1	6.8	0.0	0.0	0.0	0.0	11.4	13.2	18.6	29.4	28.4	18.3	11.7
1964	13.9	6.6	0.0	0.0	0.0	0.0	10.7	12.6	18.1	29.1	27.5	17.3	11.3
1965	12.8	6.1	0.0	0.0	0.0	0.0	10.3	12.7	18.6	29.9	29.6	19.0	11.6
1966	14.3	6.9	0.0	0.0	0.0	0.0	11.4	13.1	17.8	28.1	29.0	19.3	11.7
1967	14.1	6.6	0.0	0.0	0.0	0.0	11.0	12.8	18.1	29.0	28.0	17.6	11.4
1968	13.0	6.2	0.0	0.0	0.0	0.0	10.5	12.2	17.6	28.3	27.5	17.9	11.1
1969	13.4	6.4	0.0	0.0	0.0	0.0	10.8	12.6	17.6	28.6	28.3	17.7	11.3
1970	13.1	6.3	0.0	0.0	0.0	0.0	10.6	12.7	17.9	27.3	25.4	15.7	10.7
1971	11.6	5.6	0.0	0.0	0.0	0.0	10.3	12.8	18.2	28.0	26.2	16.5	10.8
1972	12.3	6.0	0.0	0.0	0.0	0.0	10.9	12.8	18.1	28.0	26.4	16.8	10.9
1973	12.5	6.0	0.0	0.0	0.0	0.0	10.1	12.3	17.6	27.2	26.1	17.3	10.8
1974	13.5	6.5	0.0	0.0	0.0	0.0	11.0	12.5	16.9	25.3	23.3	14.5	10.3
1975	10.9	5.3	0.0	0.0	0.0	0.0	9.8	11.7	16.6	26.2	24.2	14.7	9.9
1976	10.8	5.2	0.0	0.0	0.0	0.0	9.3	10.9	15.7	25.0	23.6	14.7	9.6
1977	10.8	5.2	0.0	0.0	0.0	0.0	9.0	10.6	14.5	21.9	20.8	13.4	8.8
1978	10.1	4.9	0.0	0.0	0.0	0.0	10.6	12.7	18.1	29.0	29.1	18.7	11.1
1979	13.9	6.7	0.0	0.0	0.0	0.0	11.0	12.7	17.6	27.7	28.2	18.8	11.4
1980	13.8	6.6	0.0	0.0	0.0	0.0	11.0	12.6	17.4	26.7	25.0	15.7	10.7
1981	11.6	5.6	0.0	0.0	0.0	0.0	9.4	10.8	14.6	22.5	21.8	13.6	9.2
1982	9.8	4.7	0.0	0.0	0.0	0.0	8.2	10.3	16.5	27.7	26.9	17.4	10.1
1983	13.2	6.5	0.0	0.0	0.0	0.0	10.8	12.5	17.6	27.3	26.0	16.3	10.9
1984	12.1	5.9	0.0	0.0	0.0	0.0	10.8	12.6	17.6	27.2	25.4	15.7	10.6
1985	11.6	5.6	0.0	0.0	0.0	0.0	9.7	11.0	14.7	21.7	19.7	12.3	8.9
1986	9.2	4.5	0.0	0.0	0.0	0.0	10.0	12.4	17.6	27.7	26.4	17.1	10.4
1987	13.4	6.6	0.0	0.0	0.0	0.0	10.8	12.5	17.5	26.7	24.7	15.4	10.6
1988	11.5	5.6	0.0	0.0	0.0	0.0	9.2	10.6	14.4	21.3	19.3	12.1	8.7
1989	9.0	4.3	0.0	0.0	0.0	0.0	7.4	8.7	12.0	18.3	17.3	11.2	7.4
1990	8.6	4.2	0.0	0.0	0.0	0.0	7.4	8.9	12.7	19.4	18.2	11.6	7.6
1991	8.7	4.2	0.0	0.0	0.0	0.0	7.1	10.4	17.7	27.5	26.1	16.4	9.8
1992	12.2	5.9	0.0	0.0	0.0	0.0	9.8	11.2	15.6	24.5	23.2	14.2	9.7
1993	10.5	5.1	0.0	0.0	0.0	0.0	10.3	12.4	17.5	28.1	28.0	18.2	10.8
1994	13.6	6.5	0.0	0.0	0.0	0.0	10.7	12.4	16.8	25.3	23.3	14.4	10.2
1995	10.9	5.3	0.0	0.0	0.0	0.0	9.4	11.6	17.4	27.3	25.4	15.7	10.2
1996	11.6	5.6	0.0	0.0	0.0	0.0	10.5	12.5	17.5	26.4	24.3	15.3	10.3
1997	11.5	5.6	0.0	0.0	0.0	0.0	10.8	12.5	17.6	27.9	27.8	18.0	11.0
Mean													
1984-97	11.0	5.3	0.0	0.0	0.0	0.0	9.6	11.4	16.2	25.0	23.5	14.8	9.7
1969-80	12.2	5.9	0.0	0.0	0.0	0.0	10.4	12.2	17.2	26.7	25.5	16.2	10.5
1955-97	11.8	5.7	0.0	0.0	0.0	0.0	9.9	11.8	16.8	26.2	25.1	15.9	10.3

Angostura Reservoir Historic Monthly Canal Discharge, HYDROMET RES070 (cfs)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.1	187.0	175.6	109.2	43.7
1956	19.5	0.0	0.0	0.0	0.0	0.0	10.1	81.3	164.7	240.7	224.4	166.4	75.6
1957	65.1	0.0	0.0	0.0	0.0	0.0	0.0	13.0	79.0	224.4	257.0	137.8	64.7
1958	34.2	0.0	0.0	0.0	0.0	0.0	0.0	115.5	151.3	190.3	273.2	191.6	79.7
1959	50.4	0.0	0.0	0.0	0.0	0.0	0.0	53.7	218.5	222.8	299.2	127.7	81.0
1960	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.4	90.8	235.8	156.1	57.1	48.1
1961	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	125.2	68.3	0.0	16.4
1962	0.0	0.0	0.0	0.0	0.0	0.0	1.7	94.3	21.8	112.2	235.8	132.8	49.9
1963	6.5	0.0	0.0	0.0	0.0	0.0	1.7	79.7	57.1	216.3	219.6	73.9	54.6
1964	1.6	0.0	0.0	0.0	0.0	0.0	8.4	91.1	85.7	248.8	242.3	82.3	63.4
1965	16.3	0.0	0.0	0.0	0.0	0.0	0.0	27.6	45.4	144.7	221.2	87.4	45.2
1966	26.0	0.0	0.0	0.0	0.0	0.0	0.0	78.1	164.7	167.5	156.1	107.6	58.3
1967	24.4	0.0	0.0	0.0	0.0	0.0	21.8	63.4	6.7	115.5	235.8	134.4	50.2
1968	40.7	0.0	0.0	0.0	0.0	0.0	1.7	68.3	48.7	183.8	188.7	95.8	52.3
1969	30.9	0.0	0.0	0.0	0.0	0.0	15.1	117.1	109.2	115.5	237.4	146.2	64.3
1970	24.4	0.0	0.0	0.0	0.0	0.0	0.0	35.8	10.1	268.3	255.3	85.7	56.6
1971	3.3	0.0	0.0	0.0	0.0	0.0	0.0	40.7	50.4	234.2	268.3	79.0	56.3
1972	4.9	0.0	0.0	0.0	0.0	0.0	8.4	37.4	55.5	250.5	239.1	95.8	57.6
1973	14.6	0.0	0.0	0.0	0.0	0.0	0.0	61.8	126.0	263.5	232.6	48.7	62.3
1974	3.3	0.0	0.0	0.0	0.0	0.0	13.4	112.2	137.8	276.5	198.4	52.1	66.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.3	52.1	227.7	271.6	84.0	58.6
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.9	50.4	235.8	177.3	107.6	52.3
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.4	105.9	203.3	185.4	102.5	55.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	112.6	271.6	203.3	102.5	62.1
1979	29.3	0.0	0.0	0.0	0.0	0.0	1.7	82.9	77.3	221.2	177.3	112.6	58.5
1980	34.2	0.0	0.0	0.0	0.0	0.0	16.8	86.2	84.0	287.9	226.1	92.4	69.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	25.2	50.4	114.3	247.2	281.4	139.5	71.5
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	204.9	229.3	142.8	49.2
1983	1.6	0.0	0.0	0.0	0.0	0.0	6.7	42.3	55.5	221.2	214.7	127.7	55.8
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.4	33.6	209.8	253.7	132.8	55.6
1985	0.0	0.0	0.0	0.0	0.0	0.0	15.1	112.2	119.3	253.7	214.7	77.3	66.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.9	62.2	187.0	198.4	67.2	45.5
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.0	75.6	226.1	229.3	67.2	54.2
1988	0.0	1.7	0.0	0.0	0.0	0.0	45.4	65.1	104.2	240.7	190.3	77.3	60.4
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.5	62.2	131.7	141.5	31.9	33.3
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	31.9	185.4	144.7	42.0	34.9
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	26.9	175.6	183.8	112.6	42.4
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.4	33.6	143.1	222.8	114.3	49.2
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.8	50.4	174.0	183.8	97.5	46.2
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.4	119.3	229.3	234.2	53.8	59.4
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8	201.7	263.5	131.1	51.5
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.8	75.6	257.0	242.3	65.5	56.4
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.7	183.8	123.6	114.3	38.8
Mean													
1984-97	0.0	0.1	0.0	0.0	0.0	0.0	4.3	42.3	61.5	199.9	201.9	84.6	49.6
1969-80	12.1	0.0	0.0	0.0	0.0	0.0	4.6	68.2	80.9	238.0	222.7	92.4	59.9
1955-97	10.0	0.0	0.0	0.0	0.0	0.0	4.5	53.6	74.5	208.0	213.4	97.9	55.2

Angostura Reservoir Monthly River Discharge (cfs)
River=Inflow-content-evap-canal

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	13.5	0.0	2.5	0.0	0.3	0.4	143.5	290.2	211.2	75.9	57.7	52.8	70.7
1956	52.5	88.9	85.0	85.0	90.9	88.6	85.9	86.9	38.7	34.7	21.4	17.3	64.7
1957	0.0	0.0	0.0	0.0	0.1	0.0	0.0	473.7	508.7	22.5	0.8	0.9	83.9
1958	0.0	31.7	50.9	57.7	57.2	54.3	0.4	1.9	0.0	217.2	197.4	0.8	55.8
1959	59.0	47.5	56.2	53.3	57.8	0.0	0.2	0.7	2.1	0.0	5.4	0.0	23.5
1960	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.2	0.6	0.5	1.4	4.9	0.7
1961	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.2	0.4	0.0	1.1	0.0	0.2
1962	0.2	0.4	0.0	0.0	0.8	0.7	0.1	780.5	2824.7	1228.8	44.3	0.6	406.8
1963	0.0	0.4	0.4	0.0	0.8	19.6	70.3	67.9	657.1	0.2	0.0	0.5	68.1
1964	1.0	0.6	0.0	0.0	0.0	0.0	0.5	0.2	110.4	11.1	0.0	0.0	10.3
1965	0.0	0.8	0.0	0.0	0.4	0.0	0.0	39.3	899.1	135.9	0.0	0.3	89.6
1966	0.0	0.7	0.4	0.0	0.8	111.7	92.0	2.7	0.2	0.0	0.0	0.8	17.4
1967	345.1	0.0	0.0	0.0	0.4	170.9	72.6	108.7	1848.0	208.0	0.8	0.0	229.5
1968	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	291.8	7.4	1.4	0.0	25.1
1969	0.0	0.3	0.0	0.0	0.7	20.9	12.9	3.1	0.8	673.9	0.1	0.1	59.4
1970	0.4	0.0	0.2	0.0	0.0	0.5	0.0	7.5	0.0	0.0	0.0	0.6	0.8
1971	0.0	0.0	0.3	0.0	0.0	0.5	0.0	1274.0	921.1	0.9	0.0	0.9	183.1
1972	0.0	0.2	0.6	0.0	0.0	0.8	0.1	1.8	5.9	1.3	0.0	0.0	0.9
1973	0.0	0.1	0.0	0.0	0.8	0.0	0.4	94.7	0.0	0.0	0.1	1.0	8.1
1974	1.1	0.1	0.0	59.9	151.1	53.1	92.6	0.0	0.2	0.0	0.7	0.2	29.9
1975	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	4.5	0.4
1976	0.0	0.2	0.6	0.0	0.6	0.1	0.7	0.4	0.3	0.0	0.0	0.2	0.3
1977	0.3	0.0	0.8	0.0	0.4	0.3	0.3	0.9	0.6	0.2	0.0	0.0	0.3
1978	0.3	0.0	0.0	0.0	0.0	0.7	0.0	2384.7	231.3	195.1	151.2	0.0	246.9
1979	1.9	0.0	0.0	0.0	0.0	179.3	151.6	0.0	0.0	0.4	0.0	0.0	27.8
1980	0.0	0.2	0.3	0.0	88.8	144.9	69.5	0.4	0.0	0.0	0.2	0.0	25.4
1981	0.6	0.7	0.4	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	3.0	0.4
1982	0.6	0.0	0.0	0.0	0.6	0.0	0.8	0.0	283.2	32.1	0.5	0.0	26.5
1983	0.0	0.2	11.6	25.8	40.8	90.0	70.7	100.1	12.1	0.0	3.6	0.1	29.6
1984	0.0	0.0	0.4	0.0	0.0	87.8	130.3	564.7	232.7	0.0	1.3	0.0	84.8
1985	0.3	0.5	0.0	0.0	0.6	0.6	0.0	0.1	0.0	1.2	0.6	1.1	0.4
1986	0.4	0.0	0.6	0.0	0.5	0.0	0.0	131.4	606.1	47.6	0.0	0.0	65.5
1987	25.7	40.6	49.4	0.0	42.5	517.8	183.5	85.8	80.0	1.0	0.0	0.0	85.5
1988	3.4	4.1	2.6	1.7	1.0	2.6	2.4	2.5	2.1	1.7	0.4	2.1	2.2
1989	1.7	2.1	2.0	1.7	1.8	2.6	1.0	2.3	2.2	1.6	0.5	2.7	1.9
1990	3.6	5.3	4.9	6.7	4.3	3.4	4.9	4.7	5.0	3.1	8.3	7.4	5.2
1991	7.8	6.6	5.5	4.8	5.4	4.7	5.2	680.8	1454.7	6.7	2.2	2.1	182.2
1992	3.3	2.4	1.8	1.6	1.7	2.3	0.4	0.0	1.0	0.8	0.0	0.0	1.3
1993	0.4	0.5	0.2	0.0	0.0	0.0	27.1	177.3	239.0	107.6	3.4	0.0	46.3
1994	17.9	50.0	28.6	1.0	2.1	607.5	31.0	32.4	3.7	1.2	5.2	5.3	65.5
1995	6.3	5.7	4.5	4.6	5.0	2.5	7.6	15.2	320.5	11.6	2.7	0.0	32.2
1996	1.7	0.3	0.5	0.2	0.0	0.4	5.1	337.0	205.8	5.1	3.2	8.0	47.3
1997	9.8	11.2	7.8	8.4	207.9	674.4	370.2	350.2	444.9	3.0	1.1	0.4	174.1
Mean													
1984-97	5.9	9.2	7.8	2.2	19.5	136.2	54.9	170.3	257.0	13.7	2.1	2.1	56.7
1969-80	0.3	0.1	0.2	5.0	20.2	33.4	27.3	314.0	96.7	72.6	12.7	0.6	48.6
1955-97	13.0	7.0	7.4	7.3	17.8	66.2	38.0	188.5	289.4	70.7	12.0	2.8	60.0

Evaportranspiration from the river bottom from the dam to Buffalo Gap

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	4	0	0	0	0	0	0	4	8	12	12	8	4
1956	4	0	0	0	0	0	0	4	8	12	12	8	4
1957	4	0	0	0	0	0	0	4	8	12	12	8	4
1958	4	0	0	0	0	0	0	4	8	12	12	8	4
1959	4	0	0	0	0	0	0	4	8	12	12	8	4
1960	4	0	0	0	0	0	0	4	8	12	12	8	4
1961	4	0	0	0	0	0	0	4	8	12	12	8	4
1962	4	0	0	0	0	0	0	4	8	12	12	8	4
1963	4	0	0	0	0	0	0	4	8	12	12	8	4
1964	4	0	0	0	0	0	0	4	8	12	12	8	4
1965	4	0	0	0	0	0	0	4	8	12	12	8	4
1966	4	0	0	0	0	0	0	4	8	12	12	8	4
1967	4	0	0	0	0	0	0	4	8	12	12	8	4
1968	4	0	0	0	0	0	0	4	8	12	12	8	4
1969	4	0	0	0	0	0	0	4	8	12	12	8	4
1970	4	0	0	0	0	0	0	4	8	12	12	8	4
1971	4	0	0	0	0	0	0	4	8	12	12	8	4
1972	4	0	0	0	0	0	0	4	8	12	12	8	4
1973	4	0	0	0	0	0	0	4	8	12	12	8	4
1974	4	0	0	0	0	0	0	4	8	12	12	8	4
1975	4	0	0	0	0	0	0	4	8	12	12	8	4
1976	4	0	0	0	0	0	0	4	8	12	12	8	4
1977	4	0	0	0	0	0	0	4	8	12	12	8	4
1978	4	0	0	0	0	0	0	4	8	12	12	8	4
1979	4	0	0	0	0	0	0	4	8	12	12	8	4
1980	4	0	0	0	0	0	0	4	8	12	12	8	4
1981	4	0	0	0	0	0	0	4	8	12	12	8	4
1982	4	0	0	0	0	0	0	4	8	12	12	8	4
1983	4	0	0	0	0	0	0	4	8	12	12	8	4
1984	4	0	0	0	0	0	0	4	8	12	12	8	4
1985	4	0	0	0	0	0	0	4	8	12	12	8	4
1986	4	0	0	0	0	0	0	4	8	12	12	8	4
1987	4	0	0	0	0	0	0	4	8	12	12	8	4
1988	4	0	0	0	0	0	0	4	8	12	12	8	4
1989	4	0	0	0	0	0	0	4	8	12	12	8	4
1990	4	0	0	0	0	0	0	4	8	12	12	8	4
1991	4	0	0	0	0	0	0	4	8	12	12	8	4
1992	4	0	0	0	0	0	0	4	8	12	12	8	4
1993	4	0	0	0	0	0	0	4	8	12	12	8	4
1994	4	0	0	0	0	0	0	4	8	12	12	8	4
1995	4	0	0	0	0	0	0	4	8	12	12	8	4
1996	4	0	0	0	0	0	0	4	8	12	12	8	4
1997	4	0	0	0	0	0	0	4	8	12	12	8	4
Mean													
1984-97	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	12.0	12.0	8.0	4.0
1969-80	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	12.0	12.0	8.0	4.0
1955-97	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	12.0	12.0	8.0	4.0

Total Buffalo Gap out (EOM Content diff+Res Evap+Canal+ET from bottom of river)

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	11.6	13.6	13.8	19.1	28.5	245.2	703.5	21.1	67.4	-20.0	404.8	210.7	143.3
1956	-35.5	-73.8	-16.7	-41.3	-40.5	56.1	-45.6	74.8	149.1	-34.1	26.4	-14.3	0.4
1957	11.7	29.1	29.7	25.5	43.1	93.2	115.1	847.6	72.3	117.9	139.7	44.1	130.8
1958	35.7	3.6	-34.6	-38.2	-15.8	36.8	186.1	29.7	123.3	690.9	89.5	-1.2	92.1
1959	-46.9	-39.1	-39.9	-35.3	-41.6	105.7	33.4	35.8	200.9	138.8	4.9	30.4	28.9
1960	23.7	21.8	22.8	24.9	32.2	155.7	28.9	28.2	98.1	32.6	17.1	14.8	41.7
1961	21.0	18.9	22.5	23.1	23.6	29.0	19.1	28.2	31.2	80.6	49.9	16.7	30.3
1962	24.9	19.7	16.5	19.6	109.0	118.0	18.3	1303.6	15.1	152.6	86.4	10.7	157.9
1963	50.1	18.1	19.1	23.6	161.3	108.8	18.7	92.2	87.0	102.9	24.0	115.0	68.4
1964	9.5	4.4	10.0	19.3	29.6	51.1	103.7	85.1	337.9	56.2	-4.0	10.1	59.4
1965	9.3	17.7	23.2	30.4	37.4	96.7	102.8	398.9	75.3	186.7	51.3	34.6	88.7
1966	73.1	24.5	22.4	24.8	35.2	161.5	12.2	9.4	-2.2	237.2	306.4	25.7	77.5
1967	-271.8	39.3	24.9	38.4	87.8	29.1	24.8	87.2	47.3	117.9	19.3	36.9	23.4
1968	10.0	33.5	30.0	33.3	55.9	130.5	81.3	59.3	220.4	84.3	113.0	50.6	75.2
1969	18.9	28.3	23.2	25.9	31.7	159.7	74.5	113.1	109.7	253.8	26.5	6.2	72.6
1970	21.5	29.0	30.7	22.6	68.4	119.8	127.8	98.9	-12.8	23.6	37.0	2.3	47.4
1971	33.4	30.3	25.7	22.6	81.3	137.8	383.7	122.2	53.3	40.3	22.3	29.0	81.8
1972	46.4	48.5	30.3	23.5	115.2	324.5	45.3	52.7	107.9	43.3	58.0	16.4	76.0
1973	38.2	35.2	24.5	30.3	44.2	105.8	120.6	263.8	61.3	144.5	39.6	282.6	99.2
1974	55.0	53.7	39.5	90.4	18.2	62.4	43.5	1.0	-2.3	25.5	47.1	19.6	37.8
1975	26.8	45.6	23.5	25.3	25.2	180.9	248.7	79.8	136.0	56.2	28.9	-8.3	72.4
1976	22.7	21.6	38.4	29.2	57.0	107.2	54.7	65.4	251.4	68.1	66.5	21.3	67.0
1977	21.6	21.0	20.4	22.3	32.0	76.1	108.9	25.8	49.4	73.6	51.1	77.7	48.3
1978	46.0	25.6	28.1	26.6	27.1	799.5	84.0	154.8	116.2	324.3	163.3	28.8	152.0
1979	31.4	25.2	33.1	30.7	25.6	77.7	4.7	60.1	72.3	167.7	331.9	22.6	73.6
1980	21.9	26.6	20.8	28.3	130.8	17.7	9.5	32.8	88.7	4.6	93.1	9.9	40.4
1981	24.5	24.5	38.6	42.0	44.7	30.8	12.0	41.5	20.2	226.5	164.1	-37.0	52.7
1982	39.2	27.6	25.0	25.1	69.6	96.5	39.5	290.5	434.0	108.4	172.5	102.9	119.2
1983	109.7	46.9	22.6	23.5	110.4	14.1	26.8	45.4	84.9	66.5	83.2	9.6	53.6
1984	49.9	38.6	28.9	36.9	148.2	237.5	19.3	52.5	49.2	37.2	49.8	26.8	64.6
1985	37.8	36.5	24.7	29.0	30.1	136.0	40.7	0.7	10.5	62.8	68.3	32.1	42.4
1986	34.5	25.3	23.8	29.1	150.8	402.3	353.5	84.0	107.8	97.8	21.0	146.7	123.1
1987	196.2	1.5	-18.5	40.6	89.0	15.6	13.1	67.8	50.7	17.5	27.0	29.6	44.2
1988	18.5	29.5	26.6	20.3	35.0	72.2	26.2	40.5	19.4	42.9	50.6	32.8	34.5
1989	18.5	23.1	24.0	21.2	25.2	78.7	37.6	48.8	15.9	38.1	24.6	109.5	38.8
1990	26.4	30.0	26.0	25.9	35.3	115.3	57.3	96.8	31.6	64.2	41.1	22.4	47.7
1991	27.1	25.3	20.5	21.6	37.8	45.7	33.5	973.9	35.6	59.0	16.3	21.0	109.8
1992	21.9	37.9	27.5	29.4	52.3	51.4	26.5	25.4	45.6	73.0	43.4	27.0	38.4
1993	23.1	24.7	24.2	27.1	30.7	428.0	258.6	26.7	103.4	197.1	158.2	41.6	112.0
1994	31.6	-28.1	0.7	45.6	136.6	0.7	34.5	23.6	14.4	30.3	39.4	16.2	28.8
1995	53.0	21.2	32.9	45.6	97.6	85.3	56.2	314.1	119.4	44.3	30.4	28.3	77.4
1996	36.5	50.2	27.1	33.6	99.3	230.6	157.9	68.8	39.2	-2.9	67.4	43.7	70.9
1997	38.1	39.2	31.2	77.1	489.0	-6.0	14.6	16.5	55.5	178.1	121.5	27.7	90.2
Mean													
1984-97	43.8	25.3	21.4	34.5	104.0	135.2	80.7	131.4	49.9	67.1	54.2	43.2	65.9
1969-80	32.0	32.6	28.2	31.5	54.7	180.8	108.8	89.2	85.9	102.1	80.4	42.3	72.4
1955-97	25.5	22.7	20.2	26.0	67.1	130.7	91.1	148.6	88.2	104.9	80.8	41.3	70.6

Total Buffalo Gap In minus Out

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	40.0	31.9	38.7	36.3	36.0	77.6	218.0	327.3	241.9	90.0	124.1	117.5	115.0
1956	82.9	123.4	129.8	127.9	130.3	129.5	116.6	119.9	66.0	52.4	39.2	36.3	96.2
1957	21.4	29.8	35.7	35.6	37.6	36.3	53.5	721.5	597.7	53.5	15.7	24.4	138.6
1958	32.9	70.9	86.4	95.0	97.4	99.2	51.2	27.9	32.9	296.4	216.3	22.7	94.1
1959	87.9	82.6	94.2	91.3	93.4	52.0	29.4	30.2	29.9	34.7	18.0	18.4	55.2
1960	26.7	36.2	37.2	37.5	37.7	47.8	29.1	24.6	17.8	12.5	13.8	22.0	28.6
1961	18.7	29.9	36.3	37.1	35.7	34.2	26.7	23.1	21.3	22.8	13.2	18.1	26.4
1962	22.5	32.7	35.6	34.7	37.9	42.8	26.8	840.0	2917.4	1278.5	60.0	17.3	445.5
1963	30.7	38.2	33.7	35.3	46.5	73.2	105.5	94.3	736.1	26.3	15.4	28.9	105.3
1964	34.2	39.9	35.8	34.5	34.8	34.1	40.7	27.8	158.6	25.9	13.0	18.0	41.4
1965	23.1	36.8	35.8	37.4	37.6	35.9	33.4	117.5	956.5	187.9	17.2	24.7	128.7
1966	34.7	38.1	37.5	37.0	38.2	195.3	130.6	25.5	17.3	28.1	37.8	24.1	53.7
1967	376.4	33.5	35.9	36.5	38.6	206.7	111.5	147.2	2485.3	261.8	16.7	21.1	314.3
1968	29.9	39.0	38.6	39.1	42.8	35.8	97.1	48.9	453.0	69.5	31.0	24.5	79.1
1969	29.1	34.4	31.3	35.6	37.7	68.2	48.0	24.3	22.1	715.4	17.8	19.0	90.3
1970	32.5	31.2	33.3	31.2	33.9	36.1	37.1	30.1	22.1	11.3	11.8	23.2	27.8
1971	30.8	31.6	31.6	33.7	38.7	37.5	37.9	1414.5	1012.5	18.4	9.8	27.2	227.0
1972	29.1	38.4	40.9	34.4	36.4	40.1	30.2	27.9	36.4	16.5	11.6	17.8	30.0
1973	26.1	32.0	35.4	34.2	38.1	47.5	61.1	150.6	14.1	13.9	12.3	28.7	41.2
1974	28.2	29.0	33.3	106.4	197.8	87.7	165.2	22.1	17.5	10.4	10.4	14.8	60.2
1975	22.6	31.7	32.3	33.6	33.8	34.2	31.7	22.0	22.0	25.6	14.1	24.9	27.4
1976	20.4	28.9	31.9	33.9	35.3	35.1	31.3	34.0	35.8	14.4	18.8	19.8	28.3
1977	26.7	31.1	34.6	33.2	32.2	32.0	31.4	25.0	19.9	13.2	14.7	19.4	26.1
1978	27.4	36.6	34.8	34.5	34.8	102.6	30.5	2449.7	253.4	208.9	166.4	17.7	283.1
1979	30.3	32.9	36.3	36.3	36.2	218.8	184.3	22.3	17.1	14.7	33.1	21.2	57.0
1980	27.8	33.8	33.8	36.9	149.6	187.3	107.0	19.9	14.1	7.6	10.0	15.0	53.6
1981	24.8	35.1	33.1	32.7	32.8	30.4	23.5	23.2	15.2	12.7	19.4	25.7	25.7
1982	27.1	31.4	33.6	33.2	34.7	32.3	28.6	67.4	396.1	51.7	39.1	26.5	66.8
1983	31.1	34.7	45.3	59.9	75.2	124.1	106.3	147.0	35.4	14.2	21.1	14.9	59.1
1984	24.3	33.5	31.5	35.0	36.9	120.5	173.8	651.0	311.0	26.0	18.9	24.8	123.9
1985	31.2	37.4	36.5	30.2	34.3	38.1	27.4	20.3	18.8	10.3	15.4	24.3	27.0
1986	30.9	34.1	37.4	36.5	41.7	82.6	80.5	172.8	732.1	79.2	14.2	25.7	114.0
1987	60.8	74.0	81.8	33.1	82.6	590.3	230.3	121.1	111.7	17.1	14.6	21.1	119.9
1988	32.0	36.8	36.9	38.5	37.3	37.3	27.8	26.7	16.2	11.5	14.5	23.8	28.3
1989	28.5	35.4	34.3	34.8	35.5	35.0	30.6	25.3	20.8	14.2	13.2	21.7	27.4
1990	25.7	36.8	37.2	40.4	38.5	37.7	38.2	28.9	31.7	14.9	21.2	23.2	31.2
1991	29.8	36.7	32.7	35.9	39.5	38.1	41.4	883.6	1549.7	27.1	17.2	21.5	229.4
1992	32.5	34.4	35.2	35.1	35.1	34.7	34.2	21.6	24.0	19.4	12.7	23.3	28.5
1993	28.2	35.2	33.3	32.6	32.5	107.2	113.3	210.6	294.3	159.7	22.0	26.7	91.3
1994	52.5	86.3	63.7	34.1	35.7	651.5	69.4	57.2	24.3	15.2	16.2	25.4	94.3
1995	29.2	35.8	37.8	38.6	43.3	36.9	48.5	74.2	410.7	52.7	26.5	27.1	71.8
1996	37.5	39.1	38.1	37.6	36.5	37.8	47.2	408.7	249.2	27.6	23.9	35.3	84.9
1997	42.8	49.8	45.5	56.9	259.8	713.9	413.3	404.4	553.8	58.5	34.5	33.0	222.2
Mean													
1984-97	34.7	43.2	41.6	37.1	56.4	183.0	98.3	221.9	310.6	38.1	18.9	25.5	92.4
1969-80	27.6	32.6	34.1	40.3	58.7	77.3	66.3	353.5	123.9	89.2	27.6	20.7	79.3
1955-97	41.0	41.0	42.2	42.9	55.4	111.1	79.1	236.3	349.2	95.9	30.4	25.4	95.8

Return Flow

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1956	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1957	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1958	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1959	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1960	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1961	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1962	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1963	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1964	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1965	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1966	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1967	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1968	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1969	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1970	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1971	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1972	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1973	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1974	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1975	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1976	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1977	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1978	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1979	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1980	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1981	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1982	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1983	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1984	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1985	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1986	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1987	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1988	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1989	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1990	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1991	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1992	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1993	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1994	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1995	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1996	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1997	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
Mean													
1984-97	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1969-80	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1
1955-97	41.9	34.8	31.4	20.6	27.1	25.7	23.6	28.8	36.4	36.6	41.4	49.0	33.1

Cheyenne River at Buffalo Gap with Reservoir (Buff In and Out plus Return Flow)

Year	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Mean
1955	81.9	66.7	70.1	56.9	63.1	103.3	241.6	356.1	278.3	126.6	165.5	166.5	148.1
1956	124.8	158.2	161.2	148.5	157.4	155.2	140.2	148.7	102.4	89.0	80.6	85.3	129.3
1957	63.3	64.6	67.1	56.2	64.7	62.0	77.1	750.3	634.1	90.1	57.1	73.4	171.7
1958	74.8	105.7	117.8	115.6	124.5	124.9	74.8	56.7	69.3	333.0	257.7	71.7	127.2
1959	129.8	117.4	125.6	111.9	120.5	77.7	53.0	59.0	66.3	71.3	59.4	67.4	88.3
1960	68.6	71.0	68.6	58.1	64.8	73.5	52.7	53.4	54.2	49.1	55.2	71.0	61.7
1961	60.6	64.7	67.7	57.7	62.8	59.9	50.3	51.9	57.7	59.4	54.6	67.1	59.5
1962	64.4	67.5	67.0	55.3	65.0	68.5	50.4	868.8	2953.8	1315.1	101.4	66.3	478.6
1963	72.6	73.0	65.1	55.9	73.6	98.9	129.1	123.1	772.5	62.9	56.8	77.9	138.4
1964	76.1	74.7	67.2	55.1	61.9	59.8	64.3	56.6	195.0	62.5	54.4	67.0	74.5
1965	65.0	71.6	67.2	58.0	64.7	61.6	57.0	146.3	992.9	224.5	58.6	73.7	161.8
1966	76.6	72.9	68.9	57.6	65.3	221.0	154.2	54.3	53.7	64.7	79.2	73.1	86.8
1967	418.3	68.3	67.3	57.1	65.7	232.4	135.1	176.0	2521.7	298.4	58.1	70.1	347.4
1968	71.8	73.8	70.0	59.7	69.9	61.5	120.7	77.7	489.4	106.1	72.4	73.5	112.2
1969	71.0	69.2	62.7	56.2	64.8	93.9	71.6	53.1	58.5	752.0	59.2	68.0	123.4
1970	74.4	66.0	64.7	51.8	61.0	61.8	60.7	58.9	58.5	47.9	53.2	72.2	60.9
1971	72.7	66.4	63.0	54.3	65.8	63.2	61.5	1443.3	1048.9	55.0	51.2	76.2	260.1
1972	71.0	73.2	72.3	55.0	63.5	65.8	53.8	56.7	72.8	53.1	53.0	66.8	63.1
1973	68.0	66.8	66.8	54.8	65.2	73.2	84.7	179.4	50.5	50.5	53.7	77.7	74.3
1974	70.1	63.8	64.7	127.0	224.9	113.4	188.8	50.9	53.9	47.0	51.8	63.8	93.4
1975	64.5	66.5	63.7	54.2	60.9	59.9	55.3	50.8	58.4	62.2	55.5	73.9	60.5
1976	62.3	63.7	63.3	54.5	62.4	60.8	54.9	62.8	72.2	51.0	60.2	68.8	61.4
1977	68.6	65.9	66.0	53.8	59.3	57.7	55.0	53.8	56.3	49.8	56.1	68.4	59.2
1978	69.3	71.4	66.2	55.1	61.9	128.3	54.1	2478.5	289.8	245.5	207.8	66.7	316.2
1979	72.2	67.7	67.7	56.9	63.3	244.5	207.9	51.1	53.5	51.3	74.5	70.2	90.1
1980	69.7	68.6	65.2	57.5	176.7	213.0	130.6	48.7	50.5	44.2	51.4	64.0	86.7
1981	66.7	69.9	64.5	53.3	59.9	56.1	47.1	52.0	51.6	49.3	60.8	74.7	58.8
1982	69.0	66.2	65.0	53.8	61.8	58.0	52.2	96.2	432.5	88.3	80.5	75.5	99.9
1983	73.0	69.5	76.7	80.5	102.3	149.8	129.9	175.8	71.8	50.8	62.5	63.9	92.2
1984	66.2	68.3	62.9	55.6	64.0	146.2	197.4	679.8	347.4	62.6	60.3	73.8	157.1
1985	73.1	72.2	67.9	50.8	61.4	63.8	51.0	49.1	55.2	46.9	56.8	73.3	60.1
1986	72.8	68.9	68.8	57.1	68.8	108.3	104.1	201.6	768.5	115.8	55.6	74.7	147.1
1987	102.7	108.8	113.2	53.7	109.7	616.0	253.9	149.9	148.1	53.7	56.0	70.1	153.0
1988	73.9	71.6	68.3	59.1	64.4	63.0	51.4	55.5	52.6	48.1	55.9	72.8	61.4
1989	70.4	70.2	65.7	55.4	62.6	60.7	54.2	54.1	57.2	50.8	54.6	70.7	60.6
1990	67.6	71.6	68.6	61.0	65.6	63.4	61.8	57.7	68.1	51.5	62.6	72.2	64.3
1991	71.7	71.5	64.1	56.5	66.6	63.8	65.0	912.4	1586.1	63.7	58.6	70.5	262.5
1992	74.4	69.2	66.6	55.7	62.2	60.4	57.8	50.4	60.4	56.0	54.1	72.3	61.6
1993	70.1	70.0	64.7	53.2	59.6	132.9	136.9	239.4	330.7	196.3	63.4	75.7	124.4
1994	94.4	121.1	95.1	54.7	62.8	677.2	93.0	86.0	60.7	51.8	57.6	74.4	127.4
1995	71.1	70.6	69.2	59.2	70.4	62.6	72.1	103.0	447.1	89.3	67.9	76.1	104.9
1996	79.4	73.9	69.5	58.2	63.6	63.5	70.8	437.5	285.6	64.2	65.3	84.3	118.0
1997	84.7	84.6	76.9	77.5	286.9	739.6	436.9	433.2	590.2	95.1	75.9	82.0	255.3
1955-97 Predicted with Angotura Reservoir													
Mean	82.9	75.8	73.6	63.5	82.5	136.8	102.7	265.1	385.6	132.5	71.8	74.4	128.9
Max	418.3	158.2	161.2	148.5	286.9	739.6	436.9	2478.5	2953.8	1315.1	257.7	166.5	478.6
90th	92.4	101.5	91.4	79.9	123.7	230.1	195.7	736.2	948.8	241.3	80.6	77.8	259.2
75th	74.6	72.9	69.4	58.1	69.4	130.6	130.2	190.5	439.8	92.6	66.6	74.7	147.6
50th	71.7	70.0	67.2	56.2	64.7	68.5	70.8	77.7	72.2	62.5	58.6	72.3	99.9
25th	68.6	67.1	65.1	54.7	62.5	61.7	54.5	53.9	57.4	50.9	55.3	68.6	62.4
10th	64.6	65.9	63.8	53.7	61.1	59.9	51.6	51.0	53.5	48.3	53.3	66.7	60.5
Min	60.6	63.7	62.7	50.8	59.3	56.1	47.1	48.7	50.5	44.2	51.2	63.8	58.8
STD	53.6	18.4	19.5	21.1	46.5	157.1	75.1	449.6	619.1	218.7	40.4	15.0	88.7
1969-80 Predicted with Angostura Reservoir													
Mean	69.5	67.4	65.5	60.9	85.8	103.0	89.9	382.3	160.3	125.8	69.0	69.7	112.4
Max	74.4	73.2	72.3	127.0	224.9	244.5	207.9	2478.5	1048.9	752.0	207.8	77.7	316.2
90th	72.6	71.2	67.6	57.4	165.6	204.5	183.0	1316.9	268.1	227.1	73.1	76.0	246.5
75th	71.3	68.8	66.4	56.4	65.4	117.2	96.2	91.9	72.3	56.8	59.5	72.6	100.9
50th	69.9	66.6	65.0	54.9	63.4	69.5	61.1	55.3	58.5	51.2	54.6	68.6	80.5
25th	68.4	66.0	63.6	54.3	61.7	61.5	55.0	51.1	53.8	49.3	52.7	66.8	61.3
10th	64.8	64.0	63.0	53.9	60.9	60.0	54.2	50.9	50.8	47.1	51.4	64.3	60.5
Min	62.3	63.7	62.7	51.8	59.3	57.7	53.8	48.7	50.5	44.2	51.2	63.8	59.2
STD	3.2	2.7	2.5	20.0	52.4	60.7	52.9	737.7	275.5	196.3	42.3	4.3	81.5
1969-80 Historic													
Mean	70.8	70.1	61.5	59.6	85.2	100.6	87.5	333.7	155.2	125.1	65.9	70.3	107.1
Max	83.7	84.1	77.4	98.3	235.4	262.6	190.3	1909.0	1069.0	866.3	146.9	95.4	262.5
75th	75.3	73.1	72.3	63.3	78.8	115.8	83.8	94.5	79.8	64.9	67.6	76.4	102.2
50th	68.5	70.0	65.1	59.1	64.4	71.0	70.3	60.0	57.2	54.1	59.5	66.3	76.3
25th	67.0	64.3	54.9	51.1	60.2	64.0	60.8	57.0	50.5	45.8	50.0	60.5	66.1
Min	63.1	62.6	34.7	39.7	54.9	57.5	45.6	50.6	32.3	20.7	43.9	55.6	56.5
STD	5.9	6.1	13.1	14.7	49.7	58.3	46.0	601.1	279.1	225.3	26.4	12.4	67.5

Reservoir Evaporation for pass thru condition based on surface area of 2,000 acres

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1956	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1957	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1958	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1959	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1960	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1961	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1962	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1963	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1964	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1965	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1966	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1967	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1968	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1969	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1970	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1971	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1972	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1973	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1974	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1975	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1976	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1977	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1978	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1979	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1980	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1981	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1982	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1983	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1984	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1985	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1986	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1987	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1988	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1989	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1990	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1991	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1992	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1993	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1994	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1995	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1996	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
1997	6.32	3.03	0	0	0	0	4.71	5.47	7.71	12.38	12.54	8.35	5.04
Mean													
1984-97	6.3	3.0	0.0	0.0	0.0	0.0	4.7	5.5	7.7	12.4	12.5	8.4	5.0
1969-80	6.3	3.0	0.0	0.0	0.0	0.0	4.7	5.5	7.7	12.4	12.5	8.4	5.0
1955-97	6.3	3.0	0.0	0.0	0.0	0.0	4.7	5.5	7.7	12.4	12.5	8.4	5.0

Cheyenne River at Buffalo Gap Without Reservoir (Flow Through)
Res min adj inflow + Fall R. + Beaver Cr. + Beaver Cr. return + Ungaged Trib minus Res Evap pass thru - ET

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1955	41.29	46.74	54.50	55.49	64.46	322.82	916.83	338.93	293.58	45.60	504.27	311.86	249.7
1956	39.21	49.21	113.15	86.59	89.82	185.64	66.34	185.24	199.43	18.58	41.02	23.12	91.4
1957	31.40	55.93	65.35	61.11	80.70	129.52	163.87	1559.67	654.35	147.09	130.91	52.12	261.0
1958	58.24	71.52	53.82	56.78	81.65	135.94	232.64	48.21	140.52	962.93	281.19	26.06	179.1
1959	37.69	49.77	56.31	55.93	55.29	157.77	58.13	56.52	215.03	149.17	10.58	32.49	77.9
1960	40.02	55.01	60.08	62.36	69.89	203.49	53.22	43.24	100.18	20.74	10.36	21.22	61.7
1961	31.45	45.73	58.87	60.22	59.25	64.70	43.72	41.85	36.72	78.98	38.64	22.61	48.6
1962	37.06	49.37	54.17	54.29	146.94	160.86	43.07	2134.19	2916.72	1406.75	121.85	20.86	595.5
1963	70.40	53.27	52.84	58.90	207.77	181.99	119.53	177.04	807.45	104.81	14.90	127.54	164.7
1964	41.96	53.91	54.36	53.78	64.35	85.24	139.70	103.48	480.85	57.70	11.17	22.63	97.4
1965	32.34	51.52	58.97	67.82	75.04	132.66	131.55	506.99	1016.05	350.20	43.96	42.98	209.2
1966	97.42	59.59	59.84	61.82	73.34	356.87	138.05	33.56	23.40	240.99	319.68	33.50	124.8
1967	94.21	69.77	60.75	74.89	126.41	235.82	131.58	225.02	2516.92	355.30	13.86	41.63	328.8
1968	39.80	69.46	68.59	72.41	98.70	166.35	173.69	98.70	657.67	129.44	119.44	58.74	146.1
1969	38.14	59.67	54.52	61.56	69.49	227.90	117.84	127.99	116.11	944.79	19.81	23.02	155.1
1970	43.65	57.20	63.92	53.80	102.34	155.94	160.19	119.54	29.42	12.44	24.22	26.73	70.8
1971	53.85	58.86	57.32	56.32	119.98	175.24	416.87	1527.23	1050.09	34.36	8.32	39.85	299.9
1972	65.21	83.81	71.25	57.91	151.65	364.61	70.75	71.10	128.59	35.41	45.07	21.94	97.3
1973	53.92	64.17	59.88	64.44	82.33	153.28	176.99	404.97	59.67	134.03	27.32	294.89	131.3
1974	72.87	79.71	72.76	196.74	216.01	150.10	204.01	33.24	23.62	11.78	33.02	18.75	92.7
1975	39.12	74.25	55.78	58.94	58.99	215.12	275.69	92.40	142.38	57.40	18.46	24.50	92.8
1976	32.75	47.44	70.29	63.09	92.28	142.30	81.31	89.87	271.47	58.15	60.76	24.72	86.2
1977	37.93	49.07	54.94	55.49	64.20	108.10	135.65	41.36	53.63	62.45	41.24	80.78	65.4
1978	63.03	59.18	62.86	61.15	61.90	902.12	109.87	2595.02	353.91	508.81	305.14	30.16	426.1
1979	51.31	55.06	69.43	67.00	61.81	296.49	184.32	72.95	73.69	158.04	340.49	27.43	121.5
1980	39.31	57.46	54.61	65.14	280.45	204.98	111.82	43.29	87.09	9.23	78.58	19.43	87.6
1981	38.96	56.58	71.72	74.64	77.57	61.21	40.10	55.26	21.95	214.88	158.93	26.91	74.9
1982	56.01	56.00	58.60	58.30	104.33	128.82	63.38	348.44	814.41	135.68	187.10	113.00	177.0
1983	130.50	78.60	67.88	83.46	185.64	138.23	128.35	182.96	104.60	56.27	79.80	18.98	104.6
1984	63.85	69.13	60.39	71.87	185.10	358.03	188.41	694.04	344.54	38.81	44.07	35.26	179.5
1985	58.68	70.79	61.12	59.16	64.37	174.11	63.34	31.04	25.99	48.73	59.16	40.05	63.0
1986	55.12	56.39	61.19	65.58	192.55	484.94	429.25	247.37	824.17	152.59	13.09	155.99	228.2
1987	246.72	72.47	63.30	73.66	171.59	605.87	238.66	179.41	146.69	16.95	17.09	34.29	155.6
1988	40.14	63.28	63.53	58.76	72.27	109.51	49.35	57.77	20.36	29.94	40.57	40.33	53.8
1989	36.77	55.43	58.31	56.06	60.67	113.79	63.51	64.63	24.88	27.90	13.19	114.82	57.5
1990	41.78	63.77	63.21	66.34	73.84	152.98	90.77	116.25	47.60	54.72	37.78	29.23	69.9
1991	46.61	58.99	53.28	57.50	77.33	83.77	70.15	1848.05	1569.59	61.65	12.90	26.12	330.5
1992	44.08	69.32	62.70	64.55	87.37	86.13	56.01	37.48	53.91	68.05	31.52	34.03	57.9
1993	40.93	56.91	57.55	59.75	63.24	535.24	367.18	227.88	382.01	332.38	155.72	52.00	194.2
1994	73.73	55.08	64.34	79.70	172.25	652.26	99.20	71.38	26.86	21.17	31.05	25.23	114.4
1995	71.87	53.97	70.69	84.19	140.92	122.16	99.98	378.84	514.38	72.62	32.44	39.06	140.1
1996	63.68	86.25	65.26	71.23	135.76	268.33	200.40	467.96	272.63	23.38	66.73	62.63	148.7
1997	70.58	85.97	76.73	134.02	748.72	707.96	423.22	411.42	593.51	212.18	131.49	44.38	303.3
1955-97 Predicted Flow Through													
Mean	57.3	61.3	62.8	68.9	122.5	241.8	165.8	376.6	424.1	178.2	87.8	54.9	158.5
Max	246.7	86.2	113.1	196.7	748.7	902.1	916.8	2595.0	2916.7	1406.7	504.3	311.9	595.5
90th	73.6	77.7	71.1	82.7	191.2	525.2	348.9	1360.6	977.7	354.3	262.4	114.5	302.6
75th	63.8	69.4	65.3	71.5	143.9	282.4	186.4	363.6	553.9	155.3	120.6	48.2	186.8
50th	44.1	57.5	60.7	61.8	82.3	166.3	128.3	119.5	146.7	62.5	41.0	33.5	124.8
25th	39.2	54.5	56.8	58.1	67.0	131.1	68.2	57.1	53.8	34.9	19.1	24.6	82.0
10th	36.8	49.2	54.4	55.6	61.8	90.5	53.8	41.5	25.1	19.0	12.9	21.4	61.9
Min	31.4	45.7	52.8	53.8	55.3	61.2	40.1	31.0	20.4	9.2	8.3	18.8	48.6
STD	35.4	10.7	9.8	23.9	110.2	186.5	154.2	599.7	615.0	281.6	108.6	62.8	111.0
Adjusted summary statistics for predicted 1955-97 flows under current operating scenario													
Mean	79.9	72.8	70.6	60.5	79.5	133.8	99.7	262.1	382.6	129.5	68.8	71.4	125.9
Max	415.3	155.2	158.2	145.5	283.9	736.6	433.9	2475.5	2950.8	1312.1	254.7	163.5	475.6
90th	89.4	98.5	88.4	76.9	120.7	227.1	192.7	733.2	945.8	238.3	77.6	74.8	256.2
75th	71.6	69.9	66.4	55.1	66.4	127.6	127.2	187.5	436.8	89.6	63.6	71.7	144.6
50th	68.7	67.0	64.2	53.2	61.7	65.5	67.8	74.7	69.2	59.5	55.6	69.3	96.9
25th	65.6	64.1	62.1	51.7	59.5	58.7	51.5	50.9	54.4	47.9	52.3	65.6	59.4
10th	61.6	62.9	60.8	50.7	58.1	56.9	48.6	48.0	50.5	45.3	50.3	63.7	57.5
Min	57.6	60.7	59.7	47.8	56.3	53.1	44.1	45.7	47.5	41.2	48.2	60.8	55.8

Cheyenne River above reservoir water year (cfs)

1	2	3	4	5	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Year	Edgemont	Hat Cr.	Cascade	Hot Sp.	Horsehea	Horse + Runoff	Below Dam River	Canal	Total Out	Out minus Hot Spr.	Storage (cfs)	Stor plus Diff.	EOM Content Annual (kaf)	Change (kaf)	Unaccount	Unknown	Res. Adj. Inflow	E/S
1947	72.4		19.62	160			184.00		184.00	24.00								
1948	103		19.62	145			149.00		149.00	4.00								
1949	71.7		19.62	154			173.00		173.00	19.00								
1950	38.2		19.62	75.6			26.60		26.60	-49.00	3.73	-45.27	2.7	2.7				
1951	95.2	30.5	19.62	174		33.22	2.88		2.88	-171.12	131.64	-39.48	97.9	95.2	72.70	72.70		
1952	101	23.3	19.62	153		24.53	99.90		99.90	-53.10	23.23	-29.87	114.7	16.8	54.40	54.40		
1953	58.1	12.3	19.62	88.5		11.26	95.90		95.90	7.40	-48.67	-41.27	79.5	-35.2	52.53	52.53	113.8	66.56
1954	20.5	13.3	19.62	60.5		12.47	11.60		11.60	-48.90	-5.25	-54.15	75.7	-3.8	66.62	66.62	56.8	50.43
1955	144	30.5	19.62	220		33.22	66.10	44.11	110.21	-109.79	83.66	-26.13	136.2	60.5	59.35	59.35	209.9	16.07
1956	43.7	7.86	19.62	71		5.90	64.43	76.19	140.62	69.62	-90.02	-20.40	71.1	-65.1	26.30	26.30	61.0	10.45
1957	109	54.7	19.62	194		62.41	84.12	65.40	149.53	-44.47	51.71	7.24	108.5	37.4	55.17	55.17	210.4	9.12
1958	102	15.4	19.62	142		15.00	50.71	80.34	131.05	-10.95	-2.21	-13.16	106.9	-1.6	28.17	28.17	143.8	14.95
1959	24.3	9.89	19.62	47.8		8.35	22.92	81.72	104.64	56.84	-66.10	-9.26	59.1	-47.8	17.61	17.61	48.4	9.86
1960	16.4	2.77	19.62	33.1		-0.24	1.41	48.67	50.08	16.98	-18.94	-1.96	45.4	-13.7	1.73	1.73	38.4	7.25
1961	12.9	1.31	19.62	30.9		-2.00	0.83	16.73	17.56	-13.34	2.49	-10.85	47.2	1.8	8.85	8.85	25.9	5.83
1962	434	21.9	19.62	453		22.84	407.11	50.47	457.58	4.58	94.30	98.88	115.4	68.2	-76.04	-76.04	560.6	8.74
1963	99.7	11.7	19.62	125		10.54	67.45	55.31	122.76	-2.24	-3.04	-5.28	113.2	-2.2	15.82	15.82	132.4	12.70
1964	55.3	5.78	19.62	77.3		3.40	9.99	64.16	74.15	-3.15	-20.60	-23.75	98.3	-14.9	27.14	27.14	65.5	11.98
1965	141	18.4	19.62	185		18.62	88.76	45.77	134.53	-50.47	28.07	-22.40	118.6	20.3	41.02	41.02	174.2	11.56
1966	64	15.4	19.62	99.7		15.00	17.41	58.77	76.18	-23.52	4.01	-19.51	121.5	2.9	34.51	34.51	90.8	10.64
1967	118	112	19.62	283		131.54	193.00	50.75	243.75	-39.25	-26.13	-65.39	102.6	-18.9	196.93	22.00	220.3	2.69
1968	49.5	51.3	19.62	100		58.31	24.70	52.96	77.66	-22.34	6.91	-15.43	107.6	5	73.74	73.74	95.9	11.37
1969	104	8.82	19.62	139		7.06	60.25	64.85	125.10	-13.90	-7.19	-21.09	102.4	-5.2	28.15	28.15	128.0	10.05
1970	30.7	3	19.62	57		0.04	2.09	57.52	59.61	2.61	-25.03	-22.42	84.3	-18.1	22.46	22.46	44.0	9.40
1971	212	31.4	19.62	258		34.30	183.94	57.11	241.05	-16.95	9.40	-7.55	91.1	6.8	41.85	41.85	260.8	10.37
1972	41.4	3.18	19.62	84.9		0.26	3.48	58.35	61.83	-23.07	2.63	-20.44	93	1.9	20.70	20.70	72.8	8.38
1973	80.1	13.7	19.62			12.95	8.04	63.05	71.10		21.43		108.5	15.5			103.1	10.59
1974	29	12.1	19.62			11.02	28.62	66.92	95.55		-43.56		77	-31.5			63.6	11.61
1975	39	1.27	19.62			-2.05	1.35	59.46	60.81		-1.11		76.2	-0.8			68.5	8.77
1976	37.7	6.02	19.62			3.68	1.18	52.96	54.14		0.14		76.3	0.1			63.0	8.75
1977	27.2	0.61	19.5			-2.84	1.18	55.59	56.77		-20.19		61.7	-14.6			44.5	7.93
1978	309	16.6	21.2			16.45	251.24	62.78	314.01		76.05		116.7	55			394.8	4.77
1979	85.2	2.78	19.5			-0.22	27.72	59.18	86.90		-0.14		116.6	-0.1			97.0	10.21
1980	45.4	6.35	20.4			4.08	24.80	69.83	94.63		-45.08		84	-32.6			61.7	12.14
1981	38.5	0.3	18.6			-3.22	1.20	72.18	73.38		-28.48		63.4	-20.6			48.9	3.98
1982	86.7	25	19.9			26.58	25.93	49.78	75.71		55.31		103.4	40			141.5	10.45
1983	54.9	9.22	21.1			7.55	29.42	56.42	85.83		-18.11		90.3	-13.1			79.2	11.43
1984	103	22.6	21.4		6.42	23.69	85.45	56.28	141.73		-6.91		85.3	-5			145.2	10.33
1985	17.7	1.47	20.6		0.015	-1.80	1.20	66.79	67.99		-37.06		58.5	-26.8			38.7	7.80
1986	101	40.1	20.9		29.3	44.80	64.99	46.05	111.04		61.95		103.3	44.8			184.3	11.35
1987	88.8	12.8	21.3		5.75	11.86	86.06	54.89	140.96		-25.72		84.7	-18.6			125.4	10.16
1988	12	1.64	19.6		0.14	-1.60	2.50	60.98	63.48		-39.13		56.4	-28.3			32.8	8.41
1989	23.6	0.16	18.3		0.002	-3.38	2.17	33.74	35.91		-6.36		51.8	-4.6			36.6	7.08
1990	31.6	0.29	18.8		0	-3.23	5.44	35.40	40.84		0.83		52.4	0.6			48.8	7.17
1991	184	43.1	18.4		26.3	48.42	181.97	42.87	224.84		54.48		91.8	39.4			288.0	8.67
1992	13	0.66	17.8		0.21	-2.78	1.17	49.78	50.95		-25.30		73.5	-18.3			35.5	9.83
1993	94.2	34.3	16.3		11.3	37.80	47.00	46.74	93.73		51.02		110.4	36.9			154.2	9.47
1994	63	6.16	18.4		2.87	3.85	66.51	60.24	126.75		-46.46		76.8	-33.6			90.3	9.99
1995	59.9	11.4	19		3.62	10.18	32.13	52.13	84.26		10.92		84.7	7.9			105.3	10.07
1996	71.8	11.1	19.62		1.27	9.81	47.56	57.29	104.85		-0.83		84.1	-0.6			114.2	10.16
1997	95.5	28.5	19.62		13.8	30.80	174.28	39.13	213.41		33.19		108.1	24			260.3	13.73
53-97	81.61	16.43	19.58	137.49	7.21	16.24	59.01	55.80	112.33	-13.22	-0.20	-14.72	88.30	-0.15	37.13	28.38	123.98	11.85
55-97	83.57	16.59	19.58	144.48	7.21	16.44	59.25	55.80	115.06	-12.38	1.04	-11.05	88.80	0.75	34.64	24.92	125.78	9.68
55-72	100.11	22.52	19.62	144.48	ERR	23.59	74.93	57.18	132.11	-12.38	1.33	-11.05	95.69	0.96	34.64	24.92	143.51	10.08
84-97	68.51	15.31	19.29	ERR	7.21	14.89	57.03	50.16	107.20	ERR	1.76	ERR	80.13	1.27	ERR	ERR	118.54	9.59
69-80	86.73	8.82	19.80	134.73	ERR	7.06	49.49	60.63	110.12	-12.83	-2.72	-17.87	90.65	-1.97	28.29	28.29	116.82	9.41

Column	
1	Year
2	Edgemont recorded streamflow (Years 1947-97)
3	Hat Creek recorded streamflow (Years 1951-97)
4	Cascade Springs recorded streamflow (Years 1977-95)
5	Cheyenne River nr Hot Springs recorded streamflow (Years 1947-72)
6	Cheyenne River nr Hot Springs minus Edgemont recorded streamflow (Years 1947-72) (Column 5 minus 2)
7	Cheyenne River nr Hot Springs recorded streamflow minus U/S flow (Years 1947-72) (Column 5 - 2 - 1.5 X 3 - 4) 1.5X3 = ungaged flow
8	Horsehead Creek at Oelrichs recorded streamflow (Years 1984-97)
9	Horsehead Creek plus runoff (Regression with Hat Creek) (2.08X(-1.72+(.58XColumn 3)))
10	River release below Dam (1947-97)
11	Canal release below Dam (1955-97)
12	Total out below Dam (Column 10+11)
13	Total out minus Cheyenne River nr Hot Springs (Column 12-5)
14	Reservoir Storage (cfs) (Column 17X1,000/723.2)
15	Reservoir Storage plus difference (Column 14+13)
16	Recorded EOM content annual minus dead content of 8,600 AF (Years 1950-97)
17	EOM change in content (Annual difference in column 16)
18	Unaccounted flows (Column 9-15)
19	Unknown (Column 5-9-12-14)
20	Reservoir adjusted inflow is the inflow used for the AGRAOP Model
21	E/S is Reservoir evaporation and seepage (Columns 20-12-14)

Hat Creek vs. Horsehead Creek Regression Output:		
Constant		-1.7173
Std Err of Y Est		3.71768
R Squared		0.86592
No. of Observations		14
Degrees of Freedom		12
X Coefficient(s)	0.58353	
Std Err of Coef.	0.06628	

Edgemont vs. Horsehead Regression Output:		
Constant		-3.0084
Std Err of Y Est		6.58966
R Squared		0.69016
No. of Observations		10
Degrees of Freedom		8
X Coefficient(s)	0.16373	
Std Err of Coef.	0.03879	

Year	Inflows	Total Out	inflows - Out Diff.
1984	171.72	141.73	29.99
1985	40.54	67.99	-27.45
1986	243.29	111.04	132.25
1987	141.32	140.96	0.36
1988	34.35	63.48	-29.12
1989	42.14	35.91	6.24
1990	50.84	40.84	10.00
1991	322.02	224.84	97.18
1992	32.23	50.95	-18.72
1993	185.57	93.73	91.83
1994	96.64	126.75	-30.11
1995	103.57	84.26	19.30
1996	110.72	104.85	5.87
1997	186.71	213.41	-26.70
Mean	125.83	107.20	18.64

Cheyenne River below reservoir (cfs)

1	2	3	4	5	6	7	8	9	10	11	12
Year	Horse + Runoff	Ungaged Inflow	Below Dam River	Canal	Fall River	Beaver CR	Beaver Return	ET	Buffalo Gap	Estimated Return	percent
1969	7.06	7.98	60.25	64.85	22.9	5.69	2.16	10	131	42.02	64.80%
1970	0.04	0.05	2.09	57.52	21.2	6.53	1.74	10	68.2	46.60	81.01%
1971											
1972	0.26	0.29	3.48	58.35	21.7	7.83	1.09	10	72	47.61	81.60%
1973	12.95	14.63	8.04	63.05	21.9	6.59	1.71	10	76.4	33.53	53.18%
1974	11.02	12.45	28.62	66.92	20.9	5.46	2.27	10	91.8	32.09	47.96%
1975	-2.05	-2.31	1.35	59.46	21.5	7.14	1.43	10	59.2	40.09	67.43%
1976	3.68	4.16	1.18	52.96	21	6.26	1.87	10	56.5	32.03	60.47%
1977	-2.84	-3.21	1.18	55.59	21.5	6.1	1.95	10	59.5	41.98	75.52%
1978											
1979	0.77	0.87	27.52	59.18	22.3	7.9	1.05	10	91.7	42.06	71.07%
1980	5.08	5.74	24.75	69.83	21.2	5.9	2.05	10	76	26.36	37.75%
1969-80	3.60	4.07	15.85	60.77	21.61	6.54	1.73	10.00	78.23	38.44	64.08%

1 Year
2 Horsehead Creek plus runoff (Regression with Hat Creek) (Column 9 from previous sheet)
3 Ungaged flow below reservoir (Column 2X1.13)
4 River release below Dam
5 Canal release below Dam
6 Fall River recorded streamflow
7 Beaver Creek recorded streamflow
8 Beaver Creek estimated return flow
9 ET below Dam to Red Shirt
10 Cheyenne River at Buffalo Gap recorded flow
11 Estimated return flow (Column 9+10-(3+4+6+7+8)
12 Percent return flow of canal release from Reservoir (Column 11/5)